SCIENCE

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THE STUDY OF MAN[1]

IN that most amusing and instructive dialogue, entitled "Theætetus," the author Plato makes Socrates enter into a discussion with the youth by offering help as a skillful midwife to deliver him of a true and logical answer to the puzzling question: What is knowledge? When the youth replies,

> According to my present notion, he who knows perceives what he knows, and therefore I should say that knowledge is perception,

Socrates proceeds—perhaps not altogether fairly—to identify his doctrine with the celebrated saying of Protagoras. This saying is about all we know of the positive teachings of him who was esteemed to be the founder of the Sophists. The proposition as expressed in the same Dialogue runs as follows:

> Man is the measure of all things; of that which is, how it is; of that which is not, how it is not.

Even in the time of Plato the Sophists had translated this proposition into the doctrine: For every person, that is true and real which appears so to him. From this doctrine it was no long step to the conclusion, that there is possible for man only a subjective and relative, not an objective and universal truth.

From the time of Protagoras to the present, the view of the nature, authority, and limits, of perception by the senses, which his celebrated *dictum* embodies, has been the chief source both of popular and of scientific and philosophical scepticism; while the resulting doctrine of the relativity of all human knowledge, in its most

[1] Address of the vice-president and chairman of Section H—Anthropology and Psychology—Cleveland, 1913.

essential features, is widely dominant in scientific circles at the present time. I propose, therefore, to make it the point of starting for the consideration of two problems: First, What have modern psychology and anthropology to say about this theory of sense-perception and its resulting or allied theory of knowledge? and, second, What results from the answer to the first question as bearing upon a correct view of the relations in which the work of psychology and philosophy—the study of man—stands to the work of the other positive sciences?

But before we even propose in more definite form these two problems, let us consider in a word our right to group psychology and anthropology together under the common term, "the study of man." That the two sciences have indeed some special relations as affiliated and mutually dependent and helpful branches of study, the very fact of this sectional meeting should seem to affirm. Indeed, so intimate are the relations between the two that there are points—and more than one of such points—where it is difficult to draw a line between them. If, for example, we speak of anthropology as inclusive of a wide range of sciences—physiology, ethnology, archeology, ethics, religion, "the rise of arts and science, and the history of civilization"—of which psychology is only one, we are met by the fact that psychology, too, has spread itself over the same territory, as affording feeding-ground for its insatiable appetite. Thus we have come to speak of physiological psychology, race psychology, the psychology of ethics, art and religion and of a so-called applied psychology, which undertakes to instruct teachers how to teach, doctors how to cure, lawyers how to examine witnesses, and even overwrought and neuropathic women how to control their eccentric and pathological tendencies.

Nor can we claim that psychology, as at present studied, confines itself to the mental or subjective side of man, while anthropology deals rather with the objective and with man's place in nature. For anthropology falls short of its highest mission and most valuable opportunity, if it does not itself make a study of the spiritual evolution of the race. (I do not, of course, employ the words "spiritual evolution" with any cant or even definitely religious significance.) Both psychology and anthropology fail of using the only method of rendering themselves scientific, if they do not proceed according to the lines marked out by the conception of development. But without further remark upon this subject, we may perhaps agree upon the conclusion that the one, psychology, is, for scientific purposes, best defined as the natural history of the individual mind, or soul; and the other, anthropology, as the natural history of the race.

Even this attempt to distinguish the two, when reflected upon from the modern scientific point of view, shows all the more clearly how intimate is the relation between them. The dependence of anthropology upon psychology, as one of the sciences which it must take into the account, is pretty generally conceded. But what is not so universally acknowledged is equally true. This is the dependence of psychology upon anthropology. No individual man can fulfil the obligation of the ancient motto, "Know thyself," without something approaching a scientific knowledge of the human species of which he is a member; of the acquired or inherent instincts, tendencies, inhibitions, naïve assumptions, emotional yearnings and strivings, which make up the greater portion of the influences controlling the so-called

nature, and natural history of the self. "Know thyself" means know thyself as a man, a member of the human race. And the natural history of the individual mind or soul, can not be described, much less explained, without interpreting it all in the light of what we have learned of the natural history of the race.

These remarks may suffice as introductory to an answer—confessedly fragmentary and full of assumptions which need proofs from sources lying outside our theme—to the two questions raised above. The first of these, you will remember, was this: What have modern psychology and anthropology to say about the view which identifies knowledge with sense-perception, and about its allied theory of knowledge?

If by perception by the senses we understand the mere fact that certain sensations form groups and sequences in consciousness, which have more or less of persistence and regularity, the banter of the wise Socrates as addressed to the youthful Theætetus is not inappropriate in our own day:

I say nothing against his doctrine, that what appears to each one to be, really is to each one, but I wonder that he did not begin his great work on Truth with a declaration that a pig or a dog-faced baboon or some other strange monster which has sensation, is the measure of all things; then, when we were reverencing him as a god, he might have condescended to inform us that he was no wiser than a tadpole and did not even aspire to be a man—would not this have produced an overpowering effect? For if truth is only sensation, and one man's discernment is as good as another's, and no man has any superior right to determine whether the opinion of any other is true or false, but each man, as we have several times repeated, is to himself the sole judge, and everything that he judges is true and right, why should Protagoras himself be preferred to the place of instruction, and deserve to be well paid, and we poor ignoramuses have to go to him, if each one is the measure of his own wisdom?

Even if we say, I do not mean the sensations of a tadpole, or even of a dog-faced baboon, but the sensations of a man, we do not establish in perception by the senses alone a ground for science. The only way we can know what the baboon actually sees, or otherwise perceives through *his* senses, is by the use of *our* powers of perception as applied to the behavior of the baboon. Our claim to superiority over the baboon, even if we are descended from him in more or less direct line, is based upon the confidence that our perceptions, as forming a ground for a scientific knowledge of things, and perhaps for a theory of the universe, are more trustworthy and comprehensive than are his. The old-fashioned way of putting this truth was not so bad after all: Man may be an animal; indeed, he undoubtedly is an animal; but man is a *rational* animal.

Psychology, with its recent more subtle analyses, as made possible by the experimental method, has made it perfectly clear that sense-perception in the case of the human individual is an exceedingly complex development, involving all man's natural and acquired capacities and forms of functioning. Into every act of the senses which gives us intimations, or assured knowledge, of real existences and actual happenings, there enter many instinctive or acquired faiths, leaps to judgment or more slowly formed inferences, emotional factors expressive of doubt, or certainty, or negation, habits favoring or prejudiced against this or that conclusion, fleeting or more fixed associated images of memory or of fancy, and formal or regulating principles, the so-called categories or "innate ideas" of the earlier philosophy. But above all, if the process of sense-perception terminates in conviction of the reality of the object perceived, or the actuality of the event observed, then this object, or those things concerned in the event, are made the centers of forces that justify us in

giving them a place in a world outside of our own conscious selves. In other words: They are endowed with a will of their own, a will that wills not as we will. That all this is a species of the personifying of things, I have myself no manner of doubt.

But the knowledge of things as gained by the senses in the case of every individual, can not separate itself from the knowledge gained in the same way by the race of which the individual is a member. The motor reactions underlying the faiths and assumptions, the accumulated contributions of the faculties of memory and imagination, as all these are incorporated into the central nervous system, are matters of the development of the race. What even the average school-boy sees and hears, as well as thinks about and reads into his experience with the senses, is not precisely the same as that of the boy in ancient Egypt or Greece, or even the boy among the savage tribes of our own day. Are not the sense-perceptions of the believer in spiritualistic phenomena and in Christian science different from those of the sceptic and disbeliever, to-day, even when we place them in as nearly as possible identical relations to the object to be perceived? Here, then, is where anthropology becomes a valuable adjunct to any theory of sense-perception.

As to the theory of the relativity of all knowledge as stimulated by and embodied in the maxim that man is the measure of all things, its falsity or truthfulness depends entirely upon what is meant by the word "relativity." In the Theætetus Plato makes Protagoras—we do not know with what right—base his doctrine on the philosophy of Heracleitus. Now, no other philosopher of antiquity has been of late so re-habilitated in reputation and so clothed with honor as has the Ephesian Heracleitus. He was the founder of natural philosophy among the Greeks, the leader of the physicists of the fifth century B.C.

So powerfully impressed was he with the ceaseless change of things, the transitoriness of all the particular, that he sees in it the most universal law of the world, and can only regard the cosmos as being involved in continual change, and transposed into perpetually new shapes. All things are in constant flux; nothing has permanence.

If by the relativity of knowledge, as established by the psychological and anthropological study of man, we mean that no other knowledge is possible for human beings than that which comes into relation with human faculties for knowledge, there can be no objection to, or denial of, so obvious a truth. All man's knowledge of mankind and of the rest of the world is *human* knowledge and comes under the limitations and conditions of all human knowledge. Man's fields of knowledge have boundaries; and what he wins from these must be by patient and skillful using of the means of culture, his own senses and intellect applied to the data of his own experience.

If by the relativity of knowledge we mean also to assert that all knowing is an actual relating, an exercise of the function of relating activity, and that all things known are known as related to other things, we are only stating undoubted psychological facts. These facts are of fundamental importance in our interpretation of the true meaning of the saying, "Man is the measure of all things." Still further, if we mean that all advance in knowledge, on the part of the individual and of the race, is related to the past stages and achievements of knowing faculty, then, too, we are stating a truth on which psychology and anthropology may cordially unite. But when by the relativity of all knowledge it is meant to imply a complete distrust of

man's ability to discover and prove anything about the reality of the world in which he lives, or to apprehend with assurance of conviction what is now actually taking place within or without, or what has actually taken place in the past, we press our scepticism and its resulting agnosticism far beyond the limits warranted by a proper understanding of the Protagorean maxim. Man is indeed the measure of all things, *i. e.*, so far as things really exist for him or actually happen in the real world which environs his existence.

So, then, he who takes his attitude toward his own science, or toward the practical life, from that study of man in which psychology and anthropology may cheerfully concur, will undoubtedly hold to a certain theory of the relativity of all knowledge. This theory will lead him to say: There are a few things of which I have perfectly certain and absolutely sure knowledge. There are some more—perhaps, many more—of which I am reasonably sure; and the surer, the more I grow in knowledge. There are yet more of which I am in doubt, and about which I am holding my mind in suspense and open to the conviction which follows upon trustworthy and sufficient evidence. But the things I do not know are like a vast and limitless sea—to borrow an illustration from the philosophy of Kant—on the bosom of which lies my little island of knowledge and opinion. How far future explorers in all branches of science may sail that boundless ocean, or what other islands they may discover or treasures bring up from its depths, I am not going dogmatically to pronounce. That would be to assume more, in view of our present relations to the past and the future of science, than any one is justified in assuming. Besides as a student of man from the anthropological point of view, I am taught to be cautiously agnostic in this regard.

But when any one says of himself, I know absolutely nothing about myself, or about things, or about the transactions between myself and things, or among things, which I am confident have a corresponding reality, he appears more modest with reference to his own powers than the doctrine of the relativity of knowledge requires that he should be. And when he goes on to say, You, too, know nothing, and can know nothing as to what is real and actual, he is not altogether polite, not to say flattering, toward a fellow aspirant for knowledge. But when he proceeds with the declaration: Neither I, nor you, nor anybody, really knows anything, or ever can know anything, about the real world and about the events assumed actually to occur in this world, his agnosticism has indeed taken a suicidal turn. For, surely such an agnostic knows that he does not know, and yet somehow exists in a world about which he and all others are in this state of perpetual and incurable ignorance; and this would seem to imply that I and others without number, in the most important respects like him, do also exist in an unknowable but undoubtedly actually existent world. It seems then that the complete agnostic is the man who is very sure that he can vindicate his agnosticism by appeal to some actual, objective standard of judgment which he and others possess in common. That is to say, while arguing from his doctrine that man is the measure of all things to the conclusion that no knowledge is possible, he involves the other very important conclusion or assumption that the world is full of actually existent rational beings, besides and outside of himself.

The importance of considerations like those just announced is greatly increased

when we apply them to the relations in which the study of man stands to that kind of knowledge which is embodied in the so-called positive sciences. The term science is properly applied to any grouping of knowledges to which has been given systematic form, and which has been based upon evidence that admits of being reviewed, estimated and, if possible, submitted to some kind of testing by comparison with other similar experiences. Thus science does not essentially differ from what we call ordinary knowledge; and when we extend the maxim which makes man the measure of all things to the positive sciences, we do not reduce their proof, their claims to acceptance as true pictures of reality, to the testimony solely of immediate sense-perception. No science consists solely or chiefly of data that can be seen, heard, handled, tasted or smelled. But all science, like all knowledge, whether we dignify it with the name of science, or not, is either envisaged or implied in data of concrete and individual experiences. And it is man's reasoning faculties which make explicit what is thus implied. For the method of all science is rationalistic, in the broad meaning of the term. In this work of rationalizing, the imagination, the faiths of reason, and even the emotional attitudes of the human mind toward truth and reality, play an important part. In every individual case, but more emphatically in the case of the race in general, every particular science is a development, an ever growing and never completed achievement of the human mind. And to this development, hypothesis, theory, deduction from known or assumed principles, are all as important and indispensable as is the correct and guarded use of the senses in perception.

In the day when our maxim was first enunciated, there was no positive science of the physical, chemical or historical sort. There was much acute observation of phenomena, especially in the sphere of the moral, political and social life of man. The ancient Greek maxims for the regulation of the conduct of life have rarely or never been surpassed. The pragmatism of that day was in important respects, both more dignified and more satisfactory than the pragmatism of the present day. The Sophists were pragmatists of the most accomplished rank. But neither ancient nor modern pragmatism can ever give us science, or account for the existence, or the estimate of the values of science, properly so called. As a commentator on this very Dialogue of Plato has said:

> The want of the Greek mind in the fourth century before Christ was not another theory of rest or motion, of being or atoms, but rather a philosophy which could free the mind from the power of abstractions and alternatives, and show how far rest and how far motion, how far the universal principle of being, and the multitudinous principle of atoms, entered into the composition of the world; which could distinguish between the true and false analogy, and allow the negative as well as the positive, a place in human thought.

It is only in comparatively recent times, however, that the different sciences of external nature and of man have devoted themselves intelligently and deliberately to the supply of that which was the want of the ancient Greek world of observation and of thought. The Greeks, for example, observed that a vacuum was created by the suction of a piston above the water in a pump. But the dictum, "Nature abhors a vacuum," was regarded as a sufficient explanation of the fact for more than two thousand years, before it was observed in jest by Galileo, that nature did not abhor a vacuum beyond ten meters. But Toricelli was the first really to explain the phenomenon by bringing it under the law of gravitation. Aristotle had observed—

and how many in our scientific age have observed for themselves?—that the sunlight, when passed through a small square hole, gives a round instead of a square image; but he explained the fact simply by saying that sunlight has a circular nature. It was centuries before astronomy established the true explanation in the fact that the sun itself is a circular body.

It was a combination of the principle sounded like a trumpet-call by Newton—"Abandon substantial forms and occult qualities and reduce natural phenomena to natural laws"—with the modification and improvement of the Baconian method of experimental induction which introduced the new era in the positive sciences of external nature. By following these principles man has made of himself a more accurate and faithful measure of all things; of that which is, how it is; and of that which is not, how it is not. But he still needs as much as ever the further study of himself, as an individual and as a race, in order so to supplement, modify, adapt and otherwise improve the principle, that all the various classes of that accepted and certified knowledge which he calls by the name of science, may benefit by this study.

I come, therefore, at once to what is the main purpose of this paper. It was announced in the second of the questions proposed at the beginning. This question concerns the more fundamental of those relations in which the study of man stands to all the other positive sciences. Generalizing these relations, I will say that the study of man as the measure of all things is entitled to set forth and expound (1) the method of science; (2) the limitations of science; (3) the ideals of science. And what it is entitled to do for science in general, it may properly suggest as desirable and true for each one of the particular sciences.

Intelligently comprehended and faithfully interpreted, the study of man, the measurer, is the only way to find out how his measuring-rod ought to be applied to the different objects which come before him in the different classes of his varied experience. Every positive science, and we might almost say every subdivision of such science, has its special, most satisfactory mode of procedure in the search for truth. That this is of necessity so was known to Aristotle as distinctly as it is known to any modern man of science. Indeed, the principle was never better stated than it was by him in the first book of the "Nichomachean Ethics." There the great Greek thinker holds that the matter of a science, *i. e.*, the facts or conceptions with which it deals, must determine its method or form, according as they admit of being stated with more or less "precision" (Ἀκρίβεια). But the Greek word which I have imperfectly translated by the English word "precision" means in Aristotle's use of it a combination of mathematical exactness, metaphysical subtlety, minuteness of detail and definiteness of assertion. And as applied to the form of science, or study of one aspect of man, namely, the ethical, which he is proposing to consider, he distinctly states that mathematical exactness is quite unsuited to ethics; that we must not expect too much subtlety, and that too much detail is to be avoided. In this respect his view is more liberal and more true to the nature, limitations and ideals of human science than is that of Sir Isaac Newton when he insists that all "natural phenomena," including the biological, shall be reduced to "mathematical laws." For every step in the evolution of science, as subjected to the conclusions derived from a study of man,

shows that a knowledge of qualities and relations of quality, many of which do not admit of a reduction to mathematical laws, is an indispensable part of all the sciences which deal with natural phenomena.

Every particular science, and, if you please, every form of experiment in each one of them all, should be allowed to determine its own method in the details of its observations, testing the alleged facts, and obvious conclusions from the facts. There is really no reason for assuming a sort of holy mystery about scientific method in general, or about any particular scientific method. Method is any means of arriving at the truth of reality. The greater truths of science, as well as of religion, have always been revealed to gifted—and for my part I am willing to say, inspired—minds, as flashes of intuition, fortunate guesses, hypotheses which as yet awaited verification but shone with that light which announces the clearer vision of the approaching day. I have always had a sneaking sympathy with that schoolboy who, when he came home from school snivelling because he could not do the sums in mental arithmetic set by his teacher, and his mother reminded him that, of course, he had been taught at home the correct answer to them all, replied: "Yes, of course, I know what the answer is, but I can't get the method."

While, then, we admit the right and repose the obligation to any special form of technique, as a matter for the particular sciences to decide for themselves, we still insist that the nature of the human mind and of its development in the individual and in the race is the source of all the experience which determines the successes and the failures in the use of every particular method in each of the particular sciences.

Still more definite but brief statements with regard to the doctrine of method which the relativity of all knowledge makes imperative would seem in place at this point. If man is to take even his preliminary measurement of things, of that which is, how it is, and of that which is not, how it is not, by sense-perception, he must use trained senses with inexhaustible patience, and with freedom from prejudice and professional pride and ambition. Some years ago the retiring president of the Association of American Naturalists, in his address at the annual banquet, related this recent experience of his own. He had written to a considerable number of the leading biologists in the country, asking that they should give him just the bare facts as they had observed them, and with no admixture of their own views in explanation, upon a certain matter which he was engaged in investigating. "Even so," said this scientific observer, "I could not get the simple unsophisticated facts reported." How many biologists and physiologists in the world at the present time, whatever confidence they may have in the ability and sincerity as an observer of Dr. Bastian, are sure he is giving them just an unprejudiced statement of the facts in proof of his theory of spontaneous generation?

The psychological study of sense-perception, as strengthened by the anthropological study of man's progress in knowledge, shows with undoubted clearness, not only that the details of every man's sense-perceptions are his very own and quite unique, but also that the influence of habit, expectation and interest, contributes largely to what the senses are bound to perceive. But the true doctrine of scientific method which follows from the study of man as a measurer of things by his senses, logically followed, does not land us in an absolute distrust of the senses, in a gulf of scepti-

cism and agnosticism with regard to all human knowledge. The rather should this study serve as a reminder, how uncertain and slow is the laying of solid foundations for the building of the temple of science; but also, how solid those foundations, when well laid, actually are; and how noble the temple which man is erecting toward the skies, on these same foundations.

Among a certain class of psychologists and philosophers—I am ashamed to confess it—there has been much deprecating and even sneering, directed toward the stern control of the logical faculties in the discovery and proof of the nature of reality. "The will to believe," or the leap of emotion to conclusions affecting the nature of reality, has been attractively offered, and far too freely accepted, as a substitute in science as well as in religion, for the use of reason under the control of reason's lawful working. But the study of man utters a loud warning against all this. Even a truly scientific mind may express itself and its findings in an alluring rhetorical style. But such a style can never be safely trusted as evidence for, however effective it may prove in exposition of, the truths of either common life or science and philosophy. Logic may be fervid, but it must still remain logic, if it is to be offered in proof of truth. On the one hand, it is true that a purely logical or dialectical construction of scientific theory, after the Platonic or the Hegelian method, when it cuts itself from the bonds which tie it down to concrete facts of more or less nearly universal experience, is not man's way to measure most faithfully the truth of things. But, on the other hand, it is equally the fact that only by the use of the intellect, the logical or so-called dialectical faculty, can the truth be explicated and interpreted as it lies hidden in the facts. The history of scientific progress shows beyond all question, that it is not great collectors of facts, but great thinkers reasoning concerning the meaning of the facts, who have most contributed to this progress.

An additional consideration of no small importance which is made quite clear by the natural history of the individual mind, as well as by the natural history of the race, is this: Knowledge is not only a matter of development, of progressive achievement, in the individual and in the race; it is also a matter of degrees. Any body of knowledge, no matter how strictly it may be entitled to the term science, will necessarily consist of propositions that are made with quite different degrees of assurance. This truth should always be frankly acknowledged in the methodical procedure of every science. Every positive science will, of course, aim to have its different conceptions, so-called laws, and fundamental principles hang well together. It will also attempt to fortify itself by coming into relations of mutual support with the other most nearly allied sciences. It will, above all, test its own conclusions by the amount of agreement which its own best students and trained experts have been able to reach as exponents of the best intellects of the race, in their prolonged and unprejudiced application to the problem of interpreting the experience of the race. But every science will also remember that the very method of science, as inexorably fixed by the nature of man's intellectual processes, makes it necessary to discriminate different degrees of knowledge, with shifting degrees of certainty and changing claims to importance, as the knowledge of the race advances in clearness and comprehension.

In this connection it is worth while simply to call attention to the fact that the mental attitudes of scepticism, criticism and agnosticism are indispensable and val-

uable factors in all scientific method. Every investigator who attempts to employ the proper method in measuring the things of his special science, is bound to be, always a critic, often a sceptic, oftener still an agnostic. But every investigator is also yet more imperatively bound to be critical, sceptical, agnostic, in right directions; and toward the different conventional opinions, and accepted conceptions and laws constituting the body of that science, in accordance with the varying degrees of evidence and proof.

One thing more on this point. The study of man in any broad and sympathetic way shows us unmistakably that an essential element in all scientific method is a certain indestructible confidence of reason in its own ability, by repeated trials and successive approaches, to reach the truth of things. Man as the measurer of all things is somewhat like those conceited tailors to whom we are sometimes compelled to resort in our efforts to get a perfectly fitting suit of clothes. He is always trying on the coat and altering it, until he has reached the limit of the cloth he has sold us; and then we must be contented with his assurance that it fits us perfectly, while in our secret thought we are troubled with the suspicion that it fits us only fairly well. At any rate, for the present the process of fitting can no further go. At the annual meeting of the British Association in 1904, there were two things, according to the reports in the newspapers, on which those in attendance were all agreed. One of these was that they had never before had quite so fine a time socially; the other was, that in none of the branches of the association was there any one where all the members were in agreement upon any one thing.

Cast a glance over the history of science in general, or over the history of any one of the particular sciences. Those who scorn philosophy under the pseudonym metaphysics are fond of making merry over the persistent and universal lack of agreement on any one point, of the philosophers from the beginning of reflective thinking until the present time. But the simple fact of history is that the more fundamental tenets of philosophy as held by the different schools have been far less subject to change than have the important conceptions and so-called laws of the particular sciences. What enormous changes have taken place in all these sciences since the improved methods of studying their data have gained general acceptance and been put into general practise! Each one of these sciences is accustomed to boast: In the last half century or less we have made all things new. And with regard to the future of science the words of Scripture are scarcely too strong to describe its apocalyptic vision:

> And I saw a new heaven and a new earth; for the first heaven and the first earth are passed away.

All man's voyage on the sea of knowledge, for the discovery, mapping out and exploiting of the new domains of science, is strewn with the wrecks of voyagers in the distant or near past. Never before were so many vagaries and visionary schemes and unproved hypotheses demanding attention and credence. But never before was the fleet of voyagers so numerous, so competent, so sound, so sure of its future, as at the present time. How can such things be? How can the measurer always be making such misfits, spoiling so much cloth, and annoying so much his patient, trustful customers, and yet retain his own immeasurable self-conceit? There are two reasons which establish the sufficient answer to this question. One of these is the indestructible faith of human reason

in itself. It hesitates, it stumbles and makes mistakes and either confesses and corrects or stubbornly adheres to them; but it never despairs or is utterly confounded. The other reason is this: History shows that this confidence is more and more, in fact, justifying itself. All progress in knowledge depends ultimately for its justification on this self-confidence of human reason; but all actual progress in knowledge is a further justification, in fact, of the confidence on which it depends. Man has faith in himself to know; in exercise of this faith, he actually attains higher and higher degrees of knowledge. While, then, constant criticism, frequent scepticism, much rather persistent agnosticism, are attitudes of the human mind toward reality, which should always characterize the method of science; scornful criticism, despairing scepticism, universal agnosticism, are essentially antagonistic to the true spirit and hopeful method of science. And those who cherish such views of the relativity of all knowledge are dissenters from the one form of faith which underlies all particular forms of faith, intellectual, social, religious. An ever present and essential feature of man's rational being is rational faith, or reason's own confidence in itself as the organon of truth.

While, then, each particular science has its own special methods of procedure in the discovery and testing of its own conceptions and laws, there is a certain universal method; or, the rather, there are certain general considerations touching a universal method, which all must observe. Three rules of method, confirmed by the psychological and anthropological study of man, provide for the patient, unprejudiced use of perception, by way of self-consciousness and through the sense, of the facts; the consistent and controlled use of the logical faculties in the interpretation and explanation of these facts; and a justifiable faith in reason as opposed to the positions of a despairing agnosticism. It is not the ancient Sophistical or the modern pragmatic interpretation of the Protagorean maxim, Man is measure of all things; of that which is, how it is; and of that which is not, how it is not, that can guide us into the safe and fruitful method to be pursued by the positive sciences. But, then, it is a comfort to know that even those devotees of these sciences who confess a faith in this interpretation, never take their faith with any large amount of practical seriousness.

A second important way in which the study of man is related to all the sciences concerns the limitations of all science. We are all familiar with the many mistaken predictions as to the limitations of particular sciences which have been made in a merely empirical way. In the "Memorabilia" Xenophon makes Socrates remark upon the impiety of men in trying to describe how the gods made the world of things; since all knowledge of this sort is forever beyond the limits of human faculty. In the "Timæus," however, Plato makes Socrates indulge in the wildest speculations, in dreams exceeding those of the poet and resembling those of the madhouse, as to how this same world may have been made. No sane student of science now believes that the actual limitations of science are of either sort—either that asserted in the "Memorabilia" or that notably transcended in the "Timæus." It is the business of science—a matter of obligation rather than a mark of impiety—to know how the natural universe was made and is being made. But when the mind assumes to dream its way into this kind of knowledge, it grossly violates the laws which inexorably fix for all time its impassable limitations. Within the fields of science itself there are constantly occurring

dogmatic statements as to what is intrinsically possible or forever impossible, for the endeavors of human knowledge. Have we not been told that the distances of the fixed stars could never be measured; that the achromatism of lenses could not be carried beyond a certain point, which has already been considerably surpassed; that steamships could never cross the ocean and airships never sail the air, in safety; that synthetic chemistry in the laboratory could never simulate the products of animal and vegetable organisms; that the speed of the nerve current could never be measured, etc., etc.

But what does all this purely empirical way of fixing the limitations of science amount to in the respect of justifying our attempts to regulate the hopeless waste of man's endeavors to know the forever unknowable? Even to-day we may be just as ignorantly—with an ignorance even made more exasperating by the fact that it is so often the outgrowth of our conceit of knowledge—denying the alleged facts of telepathy as was Newton when he refused to explain gravitation as *actio distans*. But whether this or that particular prediction come true or not, this is not the point. The point is this: that by the study of man we are able to fix certain limitations to all science which are inherent in the very nature of man himself and in his relations to that larger nature of which he is a part. It is to the consideration of this sort of limitations that we now devote a moment's attention.

That the senses, from the nature of the psychophysical organism which they serve, are limited in capacity, is a matter of course. Their anatomical structure and their forms of functioning, physiologically considered, require that the range and accuracy of their observation should be confined within certain limits, both of space and of time. In the eye, the size of the rods and cones; in the ear, the physical construction of the bony and muscular parts of the cochlea; in the skin, the frequency and arrangement of the temperature spots and the pressure spots—all these special limitations of the organism are limits to the measuring power of human sense-perception. Let these physical limitations be changed, either in the direction of improvement or of depreciation, and there would still be similar limitations inherent in the organic structure of the race, and varying with different individual members of the race. In all the various realms of sense-perception, there will always be that which lies beyond, and which can only be conjectured, or at best reasonably inferred, but which can never become immediately perceived by human senses. Surrounding the expanding island of the visible world will be the boundless sea of the invisible; of that which can be touched and handled, the many things that no skin is sensitive enough to feel and that no hand can grasp.

These limitations of the senses set their limitations to the pictorial imagination, or imaging faculty, as distinguished from what logicians have been accustomed to call "pure thought." How things would look, the like of which no eye has ever seen; how things would sound, the like of which no ear has ever heard, will remain questions to which the experience of measuring all things with the senses can give no answer.

But there are other irremovable limitations to human knowledge which are even more important, although more difficult to make obvious. These are limitations inherent in the very constitution of the intellectual powers. The intelligence of man has its own way of working, its laws of behavior, its inescapable modes of operation, to whatever subject it may be applied.

The attempt has indeed been made to account for forms, laws, innate ideas—call them what you will—as the results of a process of evolution. In my judgment, such an attempt must always remain a complete failure. The so-called primitive man in the long gone-by ages reasoned in substantially the same way as that in which the German professor of physics or the American financier or politician reasons to-day. Nor does it appear that the savage peoples of the present time have essentially different minds from our own, or are intrinsically inferior in the acuteness, speed and accuracy with which they reason. Their limitations, as compared with ours, consist chiefly, if not wholly, in the extent of the accumulations of experience with a wider world of things and of men, which lie behind them in history and which constitute their present environment. But we as well as they, and no less truly than they, when we measure things by minding them, know them only according to the formal limitations of our own minds. These limitations concern the comprehensiveness, the certainty, the range, both toward the large and toward the small, the simple and the complicated. The infinite and the infinitesimal may be symbolized and carried as symbols through complex mathematical calculations; but they can never be envisaged by the senses or comprehended by the intellect.

This sort of irremovable limitations surround all the growth and all the achievements of the particular sciences, and might be set forth at any length in the discussion of the categories of science. But such a discussion would be too technical for our present purpose and would take us much too far afield.

Some illustration of what is meant will serve our present purpose. The history of the growth of science for two thousand years shows many curious attempts to dispense with the obligations put upon the human intellect by the so-called categories, or fundamental and irreducible forms of conceiving of reality, that seem to flow from the very nature of the intellect itself. This effort among the students of physics is particularly insistent and even violent at the present time. But it is just as certainly doomed to failure now as it has ever been. For example, we are treated to a science of physics which would do away with the realistic conceptions of substance and cause, and would substitute for them the more impressionistic and phenomenal conceptions of motion and change. For do we not, with our senses, which are the measure of all things, of that which is, how it is, and of that which is not, how it is not, become actually aware of motions and of changes? But who ever saw, heard, felt, smelled or tasted, of a substance or a cause, in the metaphysical meaning of these words? Go to, then! Let us banish metaphysics and confine our scientific measurements to what the senses can actually perceive. But the conception of motion without this adjunct or underlying conception of something real that actually moves, or the conception of a change that is not caused, or compelled by, or otherwise to be attributed to, some actually existent agent, is a ghostly and intolerable conception. And the world in which relations of motion are supposed to be the sole topic for scientific investigation, is a ghostly and not a real world. But we may always observe by reading between the lines that the "scientist," because he is also a man, and is under the limitations of human intellect, has allowed to sneak in at the back door the very conceptions which he has more or less impolitely dismissed from the front. He must have a "that-which" as substance for his observed motions and as a point of

attachment for his observed changes. For reality is not made up of modern scientific, any more than of ancient philosophical, abstractions. It is, the rather, a theater in which real things are always actually doing something to one another, and in which each one is having something done to itself. There is nothing which the student of physical science more needs to learn from the study of man than that he himself is of necessity a metaphysician, and can only choose between some wisely and well thought-out metaphysical views, and a naïve, crude and misleading metaphysics of his own uninstructed self.

But the final question respecting the limitations of science as they are expounded by the study of man is this: Are they limitations of ignorance or limitations of knowledge? In other words, because there are inherent and inescapable limitations to the human intellect, are we to conclude that man as the measure of all things can really know nothing, just that it is and how it is, or are we to conclude that his knowledge, although never complete and all-comprehensive, is nevertheless knowledge indeed? And by "knowledge indeed" we mean that the real world and its actual happenings are in fact, progressively being more largely and accurately known by the combined achievements of the race? The proof of this faith, if there be proof, belongs to a department of philosophy which we are accustomed to call epistemology or theory of knowledge. In this connection I am only expressing my faith when I say that it is the same as the faith of the race.

Finally, the study of man is entitled to say what the true and worthy ideals of science are. For the scientific mind, the tenets of modern pragmatism with respect to the nature and meaning of truth can never be permanently satisfying. For science, knowledge has more than a merely practical value, and its tests are something more, and different from the mere success of its practical working. For science, knowledge has an ideal value. We are wont to express this by speaking of the worth of science for science's own sake. But the better, because the truer way to express this ideal is to say that knowledge as knowledge, and science as science, has value for man's sake. And this is because man's mind craves for, feeds upon, finds its satisfaction, uplift and refinement in, the growth of knowledge. To the human mind, or spirit, when it awakens to a realization of its call and its obligation to realize its own higher forms of privilege, and to improve its best opportunity, science affords a satisfaction that has a value of its own.

This is not to say that science has not contributed, and is not bound and glad to contribute, to the so-called practical and utilitarian in the life of man. Chemistry is not pursued with eagerness and satisfaction, and almost religious awe before the mystery of material existence, as a purely mercantile affair. But modern chemistry is transforming almost every branch of modern industry to the great practical benefit of mankind. Modern physics is not cultivated as the servant of the U. S. Steel Corporation, or the General Electric, or the Mercantile Marine monopolies. But the founders and promoters of these corporations owe every dollar of their legitimate earnings or of their graft, and the public owe all the material benefits which have fallen to them from these corporations, chiefly to modern physics.

The satisfaction of man's rational aspiration for knowledge is not, however, the only ideal which the study of man recommends for confidence and intelligent pursuit, to the other sciences. Every science,

no matter how seemingly remote from current human interests, and from man's daily life, may reasonably cherish a spirit of devotion to the social ideal. In educational circles there is just now great debate over the comparative values of the studies called abstract and those called practical, as constituting a preparation for the duties and responsibilities of "real" life. While admitting the reasonableness of this distinction and the value of certain proposals to alter the disposal of time and attention to be allotted by the average man to the two, we wish now to insist upon the thought that no form of science need be pursued, or ought to be pursued, without regard to the relation in which its pursuit stands to the social ideal. The pursuit of knowledge for knowledge's sake is itself a moral benefit to the normal man. And you can never bring about the social ideal, or advance far toward it, without discipline in the pursuit of knowledge. One of the ideals which science prizes and promotes is the ideal of a society, and finally of a race, which is so disciplined in knowledge that it may know how to be wise and upright in conduct. For, although such discipline is not the whole of what contributes to the moral and religious uplift of the race, without such discipline moral and religious progress is impossible for the race.

Hovering over all like a vast but glorious cloud that is being illumined, through the rising mists, by the rising sun, is the ideal to which the combined work of all the sciences is being directed for its better discovery and interpretation, the ideal of a universal order which has at its core, and through all its historical evolution, the unity due to rational mind. This conception in its modern outlines has been won by the toil of thousands of observers and thinkers, and slowly expanded and guaranteed, as it were, by the experience of the race. It is confessedly incomplete; perhaps it will always remain incomplete. For reality itself is no closed and once-for-all finished affair. But that the world is a realization in time and space of some such ideal as science has built up—an ideal unity of order, beauty and meaning—this is the growing conviction upon which the particular sciences, from their different points of view, and by their different methods, have been converging.

I must ask your further indulgence while I close this paper—already prolonged to an excessive length—in a fashion somewhat sermonesque, *i. e.,* with two practical and hortatory applications.

This view of man as the measure of all things calls upon those who engage in the scientific study of man, whether from the psychological or the anthropological point of view, for comprehensiveness and catholicity. All the other sciences are becoming more definitely tributary to the study of man. His marvellously complex and delicate organism traces its history through indefinite ages of evolution to an unknown and probably undiscoverable past. The description of this organism requires the combined results of the physico-chemical and biological sciences. What we call his mental and social nature and development enlists the efforts of the whole round of the psychological and historical sciences. But we are not ready for a complete and just estimate of the capacity of man as the measurer of all things until we have studied him as a speaking animal, a being with moral, artistic and religious ideals; and with a certain limited though genuine capacity for a self-controlled development in pursuit of these ideals. In a word, both psychology and anthropology are under the obligation to extend their studies, in the interests of comprehensiveness and catholicity, so as the better to understand and

master the spiritual nature and the spiritual development of the individual and of the race.

And, finally, our view of man as the measure of all things is an exhortation to an increase of sympathy and of sympathetic cooperation among all the different sciences. Of the particular sciences and their subordinate branches and subdivisions, there is an ever-increasing number. But their aim is one aim; and in the pursuit of this aim they should be as brethren dwelling together in a spirit of friendly criticism and also of friendly unity. The aim of all human science is the better to understand man by himself, and the greater nature which environs him; and the better to adjust himself to this greater nature, in the pursuit of his economic, social, artistic and religious ideals.

I venture to close with the words which Plato puts into the mouth of Socrates as he closes his conversation with Theætetus:

> But if, Theætetus, you have or wish to have any more embryo thoughts, they will be all the better for the present investigation; and if you have none, you will be soberer and humbler and gentler to other men, not fancying that you know what you do not know. These are the limits of my art; I can no further go; nor do I know aught of the things which great and famous men know or have known in this or former ages. The office of a midwife I, like my mother, have received from God; she delivered women, and I deliver men; but they must be young and noble and fair.

George Trumbull Ladd

PLEISTOCENE GEOLOGY OF NEW YORK STATE. II

LAKES

Glacial Lakes: Occurrence.—The term "glacial" is used by the writer to include only lakes which existed by virtue of a glacier ice barrier. The lakes and lakelets now existing and called "glacial" by some authors should be discriminated mostly as morainal or drift-barrier lakes.

The conditions necessary for a glacial lake are a valley or depression sloping toward and blocked by the ice front. These conditions were fulfilled in New York on so large a scale, in area and time, that the state, it is confidently believed, held the largest number and the most remarkable succession, with varied outflow, of glacial lakes of any district in the world. The reason for this superiority is found in the peculiar topography of the western part of the state. In the great Ontario-Erie basin we have a broad depression with its lowest passes on the east and west, and with a deeply trenched southern slope where lie the parallel valleys of the Finger lakes.

The only glacial lakes of which clear evidence is preserved are those which lay against the receding front of the latest ice sheet. But it should be clearly understood that every ice sheet which transgressed the state blocked the waters both during its advance and its recession.

We do not know what portions of the Valley-Heads moraine, which now constitutes the divide and forms the south limits of the basin, were left there by Prewisconsin ice sheets, but we may be quite sure that the lakes during the advance of even the last glacier were somewhat different in dimensions and relations from those of the ice recession, which are the subject of our field study. We may also be sure that the earliest ice invasion found the series of parallel valleys with fairly mature and graded forms, and open clear through to their heads, and the larger ones heading in Pennsylvania. Those earliest ice-impounded lakes must have been longer and deeper in the valleys than the lakes of later episodes, when the valleys had become more or less occupied by glacial and lake deposits. The lacustrine conditions of the episodes antedating the Laurentian ice re-

treat are as yet a matter of interesting speculation. One further difference may be noted between the ice-advance and the ice-recession lakes. The primitive lakes of the ice advance were the lowest in altitude and the most northerly in location and with the lowest outlets. As the ice advanced and closed the outlets the waters were lifted to higher levels and pushed southward. The last lakes of the ice advance being in the heads of the valleys were the smallest, the highest, the most detached and most southerly. The lakes of ice-front recession had precisely the opposite history.

Erosional Work.—The lake features that are preserved for our study may be discriminated as erosional and constructional. The erosion phenomena are the wave-cut cliffs. The glacial lakes were commonly too ephemeral or too unsteady in their levels to produce conspicuous erosion features. However, the larger and longer-lived lakes, as Newberry, Warren, Dana and specially Iroquois, have left many cliffs.

Constructional Work.—Beach Ridges, embankments of sand and gravel, the bars and spits of wave and shore current construction, are the complement of the erosion work but are much more common and are frequently very prominent features. They have long been recognized by the people as the work of mysterious waters at high altitudes. For long stretches the beach ridges have been utilized for "ridge roads," while the level stretches of wave-base along the beaches have afforded graded paths for railroads and canals. The strongest ridges are those of Whittlesey and Warren in the Erie basin, and of Iroquois in the Ontario basin.

Deltas: Of the several shore phenomena deltas are the most useful in proving the former presence and determining the altitudes of the extinct lakes. The production and size of the delta deposits are not wholly conditioned by the size of the receiving water body, but by the volume of the stream detritus relative to the distributing work of the receiving waters. Hence deltas may be built in small lakes, and these hung-up mounds and terraces of gravel on the valley sides serve well to mark the shores of lakes that were too ephemeral or too small to produce either cliffs or bars. Naturally the deltas occur in the courses of land streams, and a vertical succession of bisected delta terraces commonly indicate the falling levels of the lake. Fine examples of these gravel terraces are found on the slopes of the Finger lakes valleys and some of them are conspicuous features, like the terraces by Coy glen, visible from the Cornell University campus.

Delta Plains: Genetically related to deltas are the plains of gravel, sand or clay which may be extended in area and indefinite in limits. Such plains usually represent wave-base, perhaps twenty feet or less beneath the water surface. When partially eroded the remnants present extended horizontal lines, excellent examples of which may be seen throughout the Mohawk Valley and about the Irondequoit Valley east of Rochester, clearly visible from the trains on the New York Central Railroad. Some of the larger valleys declining toward Lake Erie exhibit broad terraces at various levels. A fine display may be seen from the Pennsylvania Railroad from East Aurora up to Machias. Evidently such lake plains can occur only north of the divide. Some plains similar in appearance in the valleys south of the divide fall into the categories of outwash plains or of river flood plains.

Scores of examples of detrital plains built in glacial waters by the land drainage might be cited. In the Erie basin the great plain in the Cattaraugus Valley below Gowanda and that built by Silver and

Walnut creeks between Forestville and Silver Creek villages may be mentioned. A very fine illustration is found on the Rochester sheet. The area between the Genesee River and Irondequoit Bay and between Lake Ontario and Iroquois beach ("Ridge Road") is the submerged delta plain of the Genesee River in Lake Iroquois, now much dissected by present-day streams. The flat stretches about Irondequoit Bay bounded by the 400-feet contour are remnants of the silt plain which in Iroquois time filled the whole breadth of the valley.

Sandplains built by the ice-border glacial drainage are also numerous. These include, for example, the plains on the west side of the Genesee Valley opposite Avon; the eroded area north and northwest of Geneva; the mesa-like plains in the Onondaga Valley at South Onondaga and northwest by Cedarvale; and the plain on which stands the business part of Syracuse.

The very extensive and conspicuous sand plains and terraces on both sides of the Champlain and Hudson valleys, including the great delta plain between Schenectady and Albany contributed by the Iromohawk River, were built in sea-level waters that occupied this depression during the time of the ice removal.

Clay Plains: Where the static waters were wide and deep so as to permit full assorting of the detritus, more or less clay was spread over the bottom in the more quiet water. The best example is found in the Iroquois Lake basin. In the St. Lawrence Valley east of Cape Vincent, Alexandria Bay and Ogdensburg are extensive stretches of finely laminated and deep clays, the glacial origin of which is indicated by the abundance of lime concretions. The heavy clay deposits of the Hudson Valley belong in this class, but were deposited in sea-level waters.

Morainal Lakes.—This class includes the hundreds of lakes and lakelets (so-called ponds) now in existence that are scattered over the state and most numerous in the Adirondacks. They owe their existence to the blockade of valleys or drainage courses by glacial drift. The term drift-barrier lakes would be the more accurate name. Great numbers of such lakes have already been obliterated, mostly changed into swamps by marl and peat accumulation or by detrital filling; and all these lakes are doomed to similar ultimate extinction either by filling or draining.

The Finger lakes probably owe their origin in part, at least in their upper levels, to drift barriers.

Cataract Lakes.—The most singular and interesting lakes in the state lie in the courses of ancient ice-border rivers. These occupy the plunge basins of extinct cataracts. Niagara to-day illustrates the method in production of a basin or bowl by the excavating work of a large cataract. If Niagara River were to be diverted above the fall so as to extinguish the cataract a rock basin holding a lake would be left in the amphitheater beneath what is now the "Horseshoe" falls. South and east of Syracuse the predecessors of Niagara River plunged over cliffs of the Onondaga limestone in their eastward flow and produced several plunge basins with lakes, two of which outrival Niagara.

The Jamesville Lake, four miles southeast of Syracuse, is a circle of emerald-green water about one eighth mile in diameter, and 60 feet deep, lying in a half-circle amphitheater with perpendicular rock walls 160 feet high. Two and one half miles east of Jamesville Lake, across the Butternut Valley, is Blue Lake, resting in a cataract basin and rock amphitheater equaling the Jamesville in dimensions but not so symmetrical. White Lake, one half

mile north of Blue Lake and Round and Green lakes nine miles east of Syracuse, have basins with low and sloping walls because the rocks are the soft Salina shales.

These lakes were formerly regarded as mysterious and with their enclosing amphitheaters were the cause of much speculation. Their nature was first announced by G. K. Gilbert and the first geologic description in recognition of their true character was by Quereau.[10]

These cataract lakes are very remarkable features, and representing as they do an ancient drainage of the Great Lakes area, held at high levels by the glacier front, they have a scientific and educational value not yet appreciated.

Lakes of Complex Origin.—This title is intended to include Lake Ontario and the larger Finger lakes, as Cayuga and Seneca, the genesis of which is not entirely clear. The bottoms of these lakes are below sea-level, and we do not know what depth of drift lies yet deeper beneath the water. At Watkins a well boring penetrated 1,200 feet without reaching rock, which shows drift at a depth 600 feet lower than the deepest part of the lake, and 750 feet beneath sea-level.

It seems probable that the valleys of the Finger lakes are blocked on the north, along the drumlin belt, by deep drift fillings, which can be determined only by borings at close intervals. That these valleys were gouged out by ice erosion, even by any number of continental ice sheets, seems to the writer extremely improbable. If they were so deepened, then the basin of Lake Ontario was probably also scooped by ice erosion. But if the Ontario basin is a depressed river valley, then the valleys of the Finger lakes must be fairly graded to the bottom of Ontario and be of similar origin. If the Ontario and other basins were excavated by river work and weathering, then it must be admitted that there have been great changes in the height and attitude of the land in late geologic time. But such changes are quite certain. It appears probable that the valley-cutting occurred during a time of land elevation, and that the Laurentian and the Finger lakes basins are the complex product of land warping, land depression, and of glacial drift filling. Until the later Tertiary and Pleistocene diastrophic movements of the area including New York have been determined and the drift-buried valleys mapped by borings the deep lake basins may remain the subject of speculation and dispute.

[10] "Topography and History of Jamesville Lake," by E. C. Quereau, Geol. Soc. Am., *Bull.*, Vol. 9, pp. 173–182, 1898. See also illustrated article by Fairchild in the 20th Ann. Rep., N. Y. State Geologist, 1900, pp. 126–129.

GLACIAL LAKE SUCCESSION

The story of the succession of the glacial waters that laved the receding front of the Laurentian glacier is a dramatic episode in the geologic history. Beginning in small pondlings of water in the heads of the valleys along the north side of the morainic divide, the lakes were enlarged as the ice barrier receded, and were captured, drained, blended or otherwise affected by changes in outlets. The romantic story can not be satisfactorily told in words alone, but requires cartographic representation, and a series of maps has been constructed to show the better known and more striking changes in the ice recession and the lake succession.

The control of the glacial waters depended on the altitude of the lowest passes affording immediate outflow along with the relation of these passes to some ultimate escape. The waters of the Laurentian basin outflow to-day by the St. Lawrence

(246 feet). With that escape blocked the lowest pass is at Rome (460 for the water surface) to the Mohawk-Hudson, and which for many thousands of years was the point of escape of the waters while the ice body lay over the St. Lawrence Valley. The next higher pass is at Chicago, which was occupied by the glacial outflow for a very long time, but to reach this ultimate escape the Ontario-Erie-Huron waters were compelled to cross Michigan by the valley of Grand River.

The lowest pass leading southward in New York is at Horseheads, the head of the Seneca Valley, leading to the Chemung-Susquehanna with altitude of 900 feet. These three outlets, Horseheads, Grand Valley, Michigan and Rome were the channels of ultimate escape for the waters of western and central New York until the ice was removed from over Covey Gulf, north of the Adirondacks. In immediate control of the waters of central New York, the Seneca-Cayuga depression and the Genesee basin, there were two localities, the salient or highland on the Batavia meridian and the highland in the Syracuse district. The earliest glacial waters in New York were held in the Genesee Valley, and this continued for a long time as a distinct basin with several successive outlets.

When we consider the glacial lakes and drainage in chronologic order we find that the earlier waters were confined in two separate basins, the Genesee and the Seneca-Cayuga. That for a brief time the Horseheads outlet (Lake Newberry) probably occupied the Genesee Valley, and then for a long time the control was alternately west on the Batavia meridian or east in the Syracuse district. Then, when the ice front weakened on the Batavia salient the westward control was across Michigan (Lake Warren level). All the later flow, subsequent to Lake Warren, was eastward to the Hudson until the northward flow through Covey Gulf and the Champlain Valley to the Hudson.

The most extended series of glacial lakes was in the Genesee Valley. This long valley, the surviving example of the Prepleistocene northward drainage, heads in Pennsylvania, at the terminal moraine, with altitude on the cols over 2,200 feet, and extends across the state to near Rochester, where it blends into the Ontario lowland at about 600 feet altitude. The fall of 1,600 feet in a right-line distance of 80 miles gave opportunity for many successively lower outlets and water planes as the ice released passes on the east or west borders of the basin. Probably the glacial lake history of the Genesee Valley is more complicated than is now known, but no less than eighteen distinct outlets with correlating lake levels have been recognized. Then the drainage was directly into the sea (Gilbert Gulf), and finally into Lake Ontario. In this varied outflow the Genesee glacial waters were contributed to several far-separated river systems. Named in order of time these are: (1) Pine creek-Susquehanna; (2) Alleghany-Ohio-Mississippi; (3) Canisteo-Chemung-Susquehanna; (4) Erie basin (Lakes Whittlesey or Warren)-Michigan basin (Lake Chicago)-Mississippi; (5) Seneca Valley (Lake Newberry)-Susquehanna; (6) Mohawk-Hudson; (7) Champlain-Hudson; (8) Ocean-level waters direct; (9) Lake Ontario-St. Lawrence. Some of these systems received the Genesee Valley overflow more than once, or by different immediate outflow, making the twenty stages in the drainage history as now understood. It would seem unlikely that any other valley in the world can approach the Genesee in the complexity of its drainage history.

The series of seventeen maps depict the waning Laurentian ice sheet with the gla-

cial and marine waters that lay against its receding border. The local lakes in the side valleys of the Hudson depression and about the Adirondack highland are not indicated; and the ice border is more or less generalized. The latter is located definitely along the lines of the ice-border drainage.

lowed up the Hudson Valley, finally reaching the Champlain basin and eventually uniting with the oceanic waters of the St. Lawrence Gulf. The Hudson inlet thus became the Hudson-Champlain inlet and finally the Hudson-Champlain strait, connecting New York Bay with the Champlain Sea. When the ice front backed away

GLACIAL LAKES OF NEW YORK STATE

Drainage Provinces						
Erie	Genesee	Seneca	Mohawk	Black	St. Lawrence	Hudson-Champlain
	1. Three Primary					
	2. Pennsylvania					
Ice	3. Wellsville	*Ice*				
	4. Belfast-Fillmore		*Ice*			
	5. Portage-Nunda	Several Primary		*Ice*		*Hudson inlet* (*marine*)
	6. Dansville					
Whittlesey	7. Mt. Morris-Genesee	Newberry				
	8. Newberry		Herkimer Schoharie Amsterdam		*Ice*	
	9. Hall	Hall				
	10. Vanuxem	Vanuxem				
Warren	11. Avon	Montezuma		Forestport Port Leyden Glenfield		
	12. Second Vanuxem	Second Vanuxem	*Glacio-Mohawk river*			*Hudson-Champlain inlet*
	13. Warren	Warren				
Dana	14. Dana	Dana				
	15. (?)					
	16. Dawson	Iroquois	*Iromohawk river*	Iroquois		
	17. Iroquois				Iroquois	
Erie	18. Second Iroquois.	Second Iroquois			Second Iroquois	
	19. *Gilbert Gulf* (*marine*)	*Gilbert Gulf* (*marine*)	*Mohawk river*	*Black river*	*Gilbert Gulf*	*Hudson-Champlain strait*
	20. *Ontario*	*Ontario*			*St. Lawronce river*	

The accompanying chart shows the time relationship of the waters in the several basins of the state. The vertical spacing is only suggestive of the succession of the waters and their geographic relations, and has little significance as to the duration of the episodes.

MARINE WATERS

During the waning of the latest ice sheet the Hudson-Champlain Valley and the St. Lawrence and Ontario basins were beneath the level of the ocean. As the ice front receded northward the sea-level waters followed up the Hudson Valley...

from the Covey Hill promontory the glacial waters of the Ontario basin, the Second Iroquois, fell to and became confluent with the sea-level waters. The highest plane of the sea-level waters in the Ontario basin is relatively weak and has not been fully determined, but an inferior level of long persistence showing heavy bar construction has been mapped and named Gilbert Gulf. This stage, which includes the series of strong bars at Covey Hill postoffice, is depicted in map number 16.

On the parallel of New York City it ap-

pears that the land at the time of the ice recession was at, or perhaps somewhat above, sea-level. Northward the land was increasingly below sea-level. The upraised and tilted water plane which indicates the amount of Pleistocene submergence or of Postpleistocene uplift rises steadily from zero or present sea-level in the district of New York City to over 750 feet on the Canadian boundary.

The supposed absence of marine fossils in the Hudson Valley is doubtless due to the freshening of the waters by the copious glacial and land drainage. Until the episode of the Second Iroquois the flood of glacial waters of the St. Lawrence basin was poured into the Hudson inlet at Schenectady. During the Second Iroquois the glacial flood was merely shifted to the north, and during all the long life of the Hudson-Champlain inlet all the fresh waters were forced south. However, marine fossils are abundant in the Champlain Valley and are found at altitudes the planes of which carry over the Fort Edward divide into the Hudson portion of the great valley.

The detrital deposits formed in the marine waters are large in volume and area. Up the Hudson as far as Catskill the terraces of clay and sand are very conspicuous and afford the materials for brick manufacture on an immense scale. North of Catskill, in the widening valley, the summit sandplains lie back from the river, though lower terraces may yet be seen. While much of the deeper deposits and those in the middle of the valley or beneath the present waters are of glacial origin, the heavy visible deposits are chiefly the deltas of tributary land streams, the greatest being that of the Iromohawk at Schenectady-Albany.

From Troy to Glens Falls the borders of the lower valley are buried in a deluge of sand, sloping down in terraces toward the axis of the valley. Saratoga lies in the midst of a vast area of detrital marine accumulations. The slow lifting of the valley out of the waters gave the latter an excellent chance to produce level stretches and conspicuous terraces, the latter being more prominent as the steeper slopes approach the middle of the valley. The Champlain portion of the great valley also holds vast sandplains, especially on the larger rivers, as the Ausable, Saranac and Big Chazy.

EPEIROGENIC MOVEMENT. DIASTROPHISM

The great changes in altitude of the surface of the state, both before and since the glacial occupation, has already been noted. The relation of the land movement to the burden of the ice cap should be briefly discussed. If the earth's crust is sensitive to long-continued pressures, then the thickness and weight of the ice body becomes an important matter.

Again our lack of knowledge of the duration and diastrophic effects of the Prewisconsin ice caps limits our discussion to the effects of the Laurentian ice body.

At its maximum the thickness of the ice cap over the Adirondacks and the Champlain Valley was probably not less than 10,000 feet. This is equal in weight to over 3,000 feet of rock. Southward the ice decreased in thickness and weight to zero in the region of New York Bay. The amount of postglacial uplift increases from zero in the district of New York Bay to over 750 feet on the north boundary of the state. The correspondence between the thickness of the ice cap and the amount of postglacial uplift of the land is very striking and significant. All about the Laurentian basin the tilted shores of the extinct glacial lakes afford us evidence of the differential uplift of the glaciated territory.

The average northward uplift or tilt of the marine plane in the Hudson and Champlain Valley appears to be about two and one fourth feet per mile, but some higher and as yet uncorrelated shore features in the Champlain Valley suggest a deeper submergence there and a larger rate of uplift. It seems quite certain that the increase of the gradient northward that is apparent west of the Adirondacks must also occur on the east of that mountain mass. The differential uplift between the Iroquois plane at Rome (460 feet) and at Covey Gulf, on the Canadian boundary (1,025? feet), is about 565 in a distance of 149 miles in a direction 33° east of north, giving a slant of 3.8 feet per mile. The grade from Richland to East Watertown is toward 6 feet per mile.

In east and west direction there is small deformation. The Iroquois plane at Hamilton, Ont., is given as 363 feet. At Rome it is 460 feet, which makes an eastward uplift of 100 feet in 225 miles, 0.4 foot per mile.

The steadiness or uniformity of the tilted marine plane in the Hudson and southern part of the Champlain valleys is somewhat surprising. It does not seem probable that all land uplifting was deferred until the ice was removed from a stretch of 200 miles and that the rise and tilting was that of a rigid mass. It would seem more likely that as the weight of the ice sheet was slowly removed it was followed by a progressive wave of land uplift. However, the final result of an epeirogenic wave-like uplift might be a fairly uniform plane, simulating that produced by tilting of a rigid surface.

POSTGLACIAL EROSION

Land erosion since the ice sheet disappeared is exhibited in wave cutting by the lakes and canyon cutting by diverted streams. In postglacial ravines New York state excels. We may recall Niagara, the three ravines in the course of the Genesee, the Ausable chasm, Watkins glen. But there are great numbers of glens or steep-walled rock gorges throughout the state which are quite as interesting and instructive as these, even if smaller and unadvertised.

When applied to the effects of erosion in New York the term "postglacial" needs explanation, for much canyon cutting was effected while the ice sheet still lingered on territory of the state. For example, the Portage ravine of the Genesee began cutting while the ice front was not far away on the north. The Mount Morris ravine, the "High Banks," was in the making while the ice covered Rochester. And the upper (south) section of the Rochester canyon was largely cut while Lake Iroquois waters prevented the excavation of the lower part of the gorge. Certainly a large part of the erosional work in central and western New York and the Hudson Valley occurred while the glacier still covered the northern lowlands of the state, including the Champlain Valley.

GLACIAL TIME

The first question commonly asked by the non-geologist is, "how long ago?" We have to admit ignorance of any precise measure of geologic time. Geologists have learned to think in millions of years, and they are not greatly concerned with the precise duration of so short a period as the glacial or postglacial episode. However, precise knowledge is desirable and a yardstick of geologic time must be sought. All attempts to use the present rate of canyon cutting or cataract recession as an index of time have failed, and no data yet discovered have much value.

The history of the ice-front recession with its long succession of lakes and well-

developed river channels compels the extension of our estimates of the length of glacial time, and all studies on glacial geology have the same result.

If we take 10,000 years as a moderate estimate of the life of Lake Ontario, then we must add an equal, and perhaps much greater, time for the lifting of the basin out of the marine waters. Then we must allow at least another 10,000 years for the duration of Lake Iroquois; and the 30,000 years carries us back only to the time when the ice sheet was removed from the western part of the state. This appears to be but a minor portion of the time covered by the waning of the glacier, judging from the maps and the known history preceding the initiation of Lake Iroquois.

If we assume 75,000 years as the time in the waning of the ice sheet, then we seem compelled to add an equal time for the invasion of the ice, with some time in addition for the pause at the terminal moraine. Most glacialists will probably agree that 150,000 years for the length of the latest or Wisconsin ice epoch is a fair estimate. And back of this we have the earlier and much longer glacial and interglacial epochs. The estimates of those best qualified to judge of the length of Pleistocene time are from 500,000 to 1,500,000 years.

WORK OF THE STATE SURVEY

The Pleistocene phenomena of the state have been the subject of casual observation and publication for over half a century, and a bibliography would be too large to present here. But the glacial and Pleistocene is the youngest member of the geologic branches of study, and only in recent years has the New York State Museum financed the glacial study as a distinct line of field-work and publication. This assistance, however, has been generous and effective, as the numerous papers and handsome maps published since 1900, and especially since 1905, will bear witness. The only elaborate and expensive maps and text published under other auspices than the State Museum is the U. S. Geological Survey Folio 169, already cited above. A description of the Moravia quadrangle by Carney was published in 1909 by Denison University, with a sketch map in black and white.

The more important Pleistocene publications of the State Museum are Bulletins 48, 83, 84 by Woodworth; 154 by Stoller, and 106, 111, 127, 145 (in part) and 160 by Fairchild. Earlier papers by the writer are contained in the 20th Annual Report of the State Geologist, 1902, 21st Report, 1903, and the 22d Report, 1904. Previous papers by the writer on the Pleistocene features of the state were published in the *Bulletin* of this society, beginning in 1895, and in other scientific journals.

For effective future work it is desirable that some scheme or far-sighted plan should bring all the glacial studies of the state into harmonious cooperation for the large result. And also that a cartographic scheme should be adopted that will secure maps as uniform in convention and color as possible.

Two important subjects requiring systematic study are the moraines and the drift-buried valleys. The state should undertake the mapping of the buried valleys. It should employ a well-boring outfit to secure data for accurate profiles of the hard-rock surfaces beneath the drift north of the Finger lakes, and wherever the Preglacial valleys of scientific interest are obscured. This would be a unique and popular work for the State Museum. The expense of such exploration would not be large, while the scientific and educational value would be great.

Another duty of the state is the preservation intact of the Jamesville and Blue lakes

cataract features. These splendid evidences of an ancient glacial drainage, antedating Niagara and corresponding in function, should be made state property and preserved for the people. They are scenic features of as much beauty and of much more educational value than Watkins Glen and some other state parks.

HERMAN L. FAIRCHILD
UNIVERSITY OF ROCHESTER

THE DIVISION OF EDUCATIONAL INQUIRY UNDER THE CARNEGIE FOUNDATION

MR. ANDREW CARNEGIE has given $1,250,000 to the Carnegie Foundation for the Advancement of Teaching. The gift was announced on the eleventh, at a meeting of the executive committee at its offices, 576 Fifth Avenue. The gift is in the form of 4 per cent. bonds and the income is to be set aside for special investigation relative to the purposes of the original foundation of pensioning college professors.

The announcement of the executive committee states that the money is to be devoted to the endowment of a Division of Educational Enquiry and makes permanent provision for studies hitherto conducted by the foundation out of its general fund. It is the plan of the trustees to proceed with the new endowment to make other studies similar to those already published concerning medical education and in particular to study legal education in its relation to the supply of lawyers and the cost of legal process.

Mr. Carnegie's letter to the trustees is as follows:

CARNEGIE CORPORATION OF NEW YORK,
January 31, 1913.

TO THE TRUSTEES OF THE CARNEGIE FOUNDATION FOR THE ADVANCEMENT OF TEACHING.

Gentlemen:—Appreciating the valuable results of the educational studies of the Foundation and being of opinion that it is desirable that a fund be established to secure such results and conduct such investigations as may aid you in your work and realizing that sufficient income may not now be available for that purpose, I hereby offer to the foundation the sum of one million and a quarter dollars four (4) per cent. bonds, to be held and used by the foundation upon the following terms:

I. There shall be organized in the foundation an agency for the study of education and educational institutions, to be designated the Division of Educational Enquiry.

II. Any endowment or funds conveyed to the foundation for the use of such division shall constitute and be held as a special fund and the income alone be used and shall be accounted for separately from the general funds of the foundation and shall be devoted to the purposes hereinafter named.

III. It shall be the function of the Division of Educational Enquiry to conduct studies and to make investigations concerning universities, colleges, professional schools, and systems of education generally, to investigate problems of education affecting the improvement of educational methods, the advancement of teaching, or betterment of educational standards, and in general to investigate and to report upon those educational agencies which undertake to deal with the intellectual, social and moral progress of mankind and to publish such results as the trustees may consider of value.

IV. The income of the Division of Educational Enquiry shall be used in the expenses incident to the performance of the work of the Division of Educational Enquiry as hereinbefore set forth, as may from time to time be undertaken and published by the foundation, but no part of the income of the fund or funds specifically given for the use of this division shall be used in the payment of pensions.

It is my purpose to aid the trustees of the foundation to conduct their work upon broad lines and to enable them to obtain such information as will make the whole endowment of the Foundation of the greatest possible service to mankind.

Yours truly,
(Signed) ANDREW CARNEGIE,
President.

THE MILWAUKEE MEETING OF THE AMERICAN CHEMICAL SOCIETY

THE forty-seventh annual meeting of the American Chemical Society will be held in Milwaukee, Wisconsin, March 25 to 28, inclusive. A meeting of the council will be held on March 24, at the Hotel Pfister, which is the hotel headquarters. The meetings will be held at Marquette University, Grand Ave. and 11th

St., where every facility is offered for the meetings of the divisions in the center of Milwaukee's business section.

Mr. C. H. Hall is chairman of the local committee and Mr. P. J. Weber, secretary. The finance committee is under the chairmanship of Mr. G. N. Prentiss. Reception, registration and information committees are under the chairmanship of Mr. E. V. Manuel. The committee on arrangement has Mr. H. W. Rohde as its chairman, Mr. F. E. Layman is chairman of the entertainment committee, and Mr. C. R. McKee is chairman of the committee on entertainment of ladies.

The entertainment committee is planning an interesting program, which will be an undoubted success, and special attention is being paid to preparations for the entertainment of ladies at such times as they can not participate in the regular program. Many manufacturing plants will be visited, and although no definite arrangements can be announced in the present circular, it may be stated that Milwaukee contains important works covering the tanning industry, manufacture of iron and steel, by-product coke and gas, manufacture of glue, manufacture of automobiles and automobile parts, automobile tires, packing industry, manufacture of refrigerating machinery, gasoline engines, kerosene engines, and shops of railroad companies, most of which will be open to the members.

All the divisions will meet. It is probable that the Biological Division will be duly organized at this meeting. Members are especially asked to note the excursion to Madison, Wisconsin, on Friday, March 28. The Society has a special invitation from President Van Hise, of the University of Wisconsin, and it is hoped that all those who attend the meeting will also go to Madison. The city is but seventy miles from Milwaukee and is of special interest, being the seat of the state capitol, the University of Wisconsin, the United States Forest Products Laboratory, and the location of a large beet-sugar refining plant, which, if present information is correct, will be in operation at the time of the convention.

All papers for the meeting must be in the secretary's hands on or before March 7 or in the hands of secretaries of divisions by March 5, in order to be on the program. By vote of the council no papers can be presented at the meeting that are not printed on the final program.

The following are the addresses of the divisional and sectional secretaries:

Industrial Division—M. C. Whitaker (*pro tem.*), Columbia University, New York City.

Physical and Inorganic—R. C. Wells, U. S. Geological Survey, Washington, D. C.

Fertilizer—J. E. Breckenridge, Carteret, N. J.

Agricultural and Food—G. F. Mason, care of Heinz Company, Pittsburgh, Pa.

Organic—Wm. J. Hale, University of Michigan, Ann Arbor, Mich.

Pharmaceutical—Frank R. Eldred, 3325 Kenwood Ave., Indianapolis, Ind.

Rubber—Dorris Whipple, care of The Safety Insulated Wire and Cable Company, Bayonne, N. J.

Biological—I. K. Phelps, Bureau of Mines, 40th and Butler Sts., Pittsburgh, Pa.

Chemical Education—J. F. Norris, Simmons College, Boston, Mass.

SCIENTIFIC NOTES AND NEWS

Sir David Gill has been elected the first honorary member of the Astronomical and Astrophysical Society of America.

Sir William Tilden, F.R.S., the British chemist, has been elected a corresponding member of the Imperial Academy of Sciences, St. Petersburg.

The gold medal of the Royal Astronomical Society has been awarded to M. Henri Alexandre Deslandres for his investigations of solar phenomena and other spectroscopic work.

The Langley medals of the Smithsonian Institution are to be conferred on M. Gustav Eiffel, the French engineer, and Mr. Glenn H. Curtiss, known for his development of the hydro-aeroplane.

Mr. F. W. Hodge, of the Bureau of American Ethnology, Smithsonian Institution, has been elected a corresponding member of the Société des Américanistes de Paris.

Professor Poulton, F. R. S., Professor Bourne, F.R.S., and Mr. E. S. Goodrich,

F.R.S., have been appointed to represent Oxford University at the International Congress of Zoology, to be held this year at Monaco.

PROFESSOR A. KEITH has been elected president of the Royal Anthropological Institute of Great Britain and Ireland.

DR. E. B. ROSA, of the Bureau of Standards, gave the address of the retiring president before the Philosophical Society of Washington on February 15. His subject was "The Function of Research and the Regulation of National Monopolies."

PROFESSOR CHARLES LAPWORTH has expressed the desire to vacate the chair of geology in Birmingham University at the end of the current session.

The Chemist and Druggist, London, reports the appointment, by the Pharmaceutical Chemistry Section of the Eighth International Congress of Applied Chemistry, of an international commission to continue the inquiry on "Variation in the activity of certain toxic drugs" and to report at St. Petersburg in 1915. The commission named is as follows: Austria, Professor Wilhelm Mitlacher; France, Professor E. Bourquelot; Germany, Professor H. Thoms; Great Britain, Francis Ransom, F.C.S.; Netherlands, Professor L. van Itallie; Switzerland, Professor A. Tscheich; United States, Dr. Rodney H. True. Three secretaries for the commission were also appointed: European Continent, George P. Forrester, F.C.S.; Great Britain, Peter MacEnau, F.C.S.; United States, Otto Raubenheimer.

PROFESSOR H. LOUIS JACKSON, B.S. (Mass. Inst., '05), who has held the position as assistant professor of chemistry in charge of foods at the University of Kansas since 1907, has accepted the position of state chemist of Idaho. He will go at once to Boise, where the laboratory is located.

FRANZ SCHNEIDER, JR., '09, instructor at the Massachusetts Institute of Technology, has accepted the position of sanitary expert to the department of surveys and exhibits, Russel Sage Foundation. For the lecture work that has been carried on by Mr. Schneider, W. C. Purdy, professor of biology at Geneva College, has been called and will be named assistant in biology.

THE Peruvian government has officially designated Mr. Charles H. T. Townsend director of entomological stations in addition to his title of government entomologist, extending his contract to December 31, 1913. A central station of agricultural entomology is already established in temporary quarters at Lima, for the general investigation of insect plagues of agriculture in the central coast region. It is intended to maintain the branch station of agricultural entomology in the department of Piura, for continuing the investigation of cotton insects and their enemies. A station of medical entomology has been established at Chosica, where an investigation of the blood-sucking arthropods of the verruga zones has already been started to determine what species may be the carrier of verruga fever. Mr. E. W. Rust has been transferred from Piura to Lima, and Mr. J. G. Cateriano has been added to the force. Several graduates from the School of Agriculture will be trained in agricultural entomology, and a graduate or two from the School of Medicine will be trained in medical entomology at Chosica.

THE Museum of Zoology, University of Michigan, will send a second expedition to Whitefish Point, Chippewa County, Michigan, in the summer of 1913, to continue the work started in that region in 1912. The 1913 work, like that of 1912, will be supported by Hon. George Shiras, and the results will be published under the same general title "Results of the Shiras Expeditions to the Whitefish Point Region, Michigan."

PROFESSOR C. E. MCCLUNG, of the University of Pennsylvania, lectured before the Society of the Sigma Xi of that university on February 7, his subject being "Sex Determination."

THE first lecture of the year before the Ohio State University Chapter of Sigma Xi Society was given by Dr. A. W. Gilbert, Cornell University, on the topic "The Method and Scope of Genetics." The officers of the Ohio State

University Chapter of the Sigma Xi Society this year are Dean David S. White of the College of Veterinary Medicine, president; J. S. Hine, associate professor of biology, vice-president; F. C. Blake, professor of physics, treasurer, and James R. Withrow, professor of industrial chemistry, secretary.

Professor A. M. Tozzer, of Harvard University, during the mid-year period, gave lectures before the various societies of the Archeological Institute of America in the following places: St. John, Halifax, Quebec, Montreal, Ottawa, Toronto, Hamilton, Buffalo, Rochester, Auburn and Syracuse.

On February 7, Professor Edward L. Thorndike, of Teachers College, Columbia University, delivered in the afternoon a lecture on "Social Instincts" before the department of psychology of the John Hopkins University; and, in the evening he addressed the Educational Society of Baltimore on "Retardation and Elimination in High School."

Professor J. S. Pray, chairman of the department of landscape gardening of Harvard University, gave recently two lectures at the University of Illinois on the subjects "Functional City Planning" and "Gardens Old and New."

Monsieur J. M. F. de Pulligny, ingenieur en chef des ponts et chaussées, et directeur, Mission Francaise d'Ingenieurs aux Etats-Unis, New York City, on February 11, delivered an illustrated lecture on "The Public Service of Roads in France," before the graduate students in highway engineering at Columbia University.

On February 4 Professor G. H. Parker lectured before the Vassar Brothers' Institute, Poughkeepsie, N. Y., on "The Evolution of the Nervous System."

The Alumni Association of the Michigan College of Mines has published its January number of *The M. C. M. Alumnus,* which is a memorial to Professor George A. Koenig, head of the department of chemistry, who died in Philadelphia on January 14. The number contains a full-page engraving from a late photograph, a biography and the addresses of the memorial service.

Professor Julius Franz, director of the astronomical observatory at Breslau, has died at the age of sixty-five years.

Dr. G. de Laval, the well-known Swedish engineer and inventor, has died at the age of sixty-seven years.

The Civil Service Commission invites attention to the regular spring examinations for scientific assistant, Department of Agriculture, to be held April 9 and 10. The entrance salaries are from $1,000 to $1,800. Examinations will be given in the following subjects: agronomy, dairying, entomology, farm economics, farm equipment, forage crops, general farm management, horticulture, library science, nutrition and calorimetry, plant breeding, plant pathology, pomology, seed testing, soil bacteriology, soil chemistry, soil surveying. An examination will be held on March 10 for senior highway engineer, to fill vacancies as they may occur in this position in the office of public roads, Department of Agriculture, at salaries ranging from $2,000 to $2,400 a year.

UNIVERSITY AND EDUCATIONAL NEWS

The sum of $75,000 has been subscribed and given to Vassar College to endow a chair of physical science.

In a recent issue of Science, mention was made of the bequests of Levi N. Stewart, of Minneapolis, to Dartmouth, Bowdoin and Bates Colleges. In addition Mr. Stewart bequeathed $75,000 to Colby College.

Mr. Dan R. Hanna, proprietor of the Cleveland *Leader and News,* has offered to the Western Reserve University ten thousand dollars a year for establishing a School of Journalism. The school will be coordinated with the other professional schools of the university, and will be its ninth department. Adelbert College, the college of arts and sciences for men, is the oldest department. It was founded as Western

Reserve College in 1826, and refounded as Adelbert College of Western Reserve University in 1882. The School of Medicine was founded in 1843, the School of Pharmacy in 1882 and the College for Women in 1888. In 1892, the School of Law, the Graduate School and the Dental School were founded. The Library School was founded in 1904.

THE actual number of law schools in the United States only increased from 102 to 118 in the decade from 1902 to 1912, according to figures compiled at the U. S. Bureau of Education, but the number of students studying law in these schools increased from 13,912 to 20,760 in same period. There were 3,524 graduates of law schools in 1902 and 4,394 last year. Law students, having a collegiate degree, doubled in the ten years. Financially the law schools show a remarkable advance. The endowment funds increased from half a million to nearly two million dollars; the grounds and buildings tripled in value; and the total income in 1912 was $1,368,000, as against $523,000 in 1902. The 387,000 volumes in the law-school libraries of 1902 had grown to 936,000 in 1912.

DR. FREDERIC LYMAN WELLS, assistant in pathological psychology at the McLean Hospital, is conducting a course of lectures and discussions on "Pathological Psychology" at Harvard University.

DR. FREDERICK G. DONNAN, F.R.S., has been appointed to the chair of general chemistry at University College, London, recently vacated by Sir William Ramsay, F.R.S.

DR. WILLIAM J. DAKIN, F.R.S., at present assistant professor at London University, has been appointed professor of biology at the University of Western Australia, Perth. Dr. Alexander D. Ross, of Scotland, has been appointed professor of mathematics and physics in the same institution.

DISCUSSION AND CORRESPONDENCE

A PLAN FOR THE ENCOURAGEMENT OF MEDICAL RESEARCH

JUDGING by the number of bequests and endowments directed toward that end, the furthering of medical research is an attractive field for philanthropic endeavor if not for public investment. As one of the rank and file who are working toward the advancement of medical science I would suggest that no method of encouraging such research has heretofore been wholly successful. The foundation of institutes for this purpose is effective in case of the favored few who happen to be reached, but for most scientists (including the clinical variety), who are engaged in teaching in medical schools, who constitute the great proportion of the working force, such foundations are of little assistance.

The most effective plan would seem to be that by which actual accomplishment is rewarded without unduly favoring any one. Such a result could be achieved by the simple expedient of endowing the periodicals devoted to the publication of research so that contributed articles could be paid for according to their merit. Such an arrangement would obviate the most discouraging feature of working in many institutions, the feeling that unusual effort is, from a selfish point of view, not merely futile but even detrimental, in that leisure for reading, recreation and family life is sacrificed without compensating gain.

The plan in operation would be simplicity itself. Rewards would go automatically to those who earned them. The chief difficulty seemingly would be to secure editorial boards fair minded enough to decide justly upon the merits of each contribution, but that difficulty would be by no means insurmountable. In any case to assign a value to a given piece of research would be much easier than to forecast which of a dozen men would be accomplishing the most effective work ten years later, a forecast which, as a matter of fact, has to be made in each instance, before a desirable research or teaching position can justly be assigned.

It is recognized that the best endeavor can not be bought, and that the best rewards of a scientific career are not pecuniary—"but that is another story!" Whatever merit there is in financial encouragement would seem best

to be secured by some such as the foregoing plan.

R. G. Hoskins
Starling Ohio Medical College

GRANA DE BRASILE

To the Editor of Science: I should be glad to learn what grain and what region were meant by "grana de Brasile" in the 1193 commercial treaty between the "Bononienses" and "Ferrarienses" copied by Muratori into Vol. 2 of his "Antiquitates Italicæ," p. 844. He mentions (p. 488) the repetition of the same item in a "charta" of 1198.

Capmany's Spanish work on the early shipping arts, etc., of Barcelona copies in Vol. 2 several thirteenth century Catalan tariff lists, three of which (the earliest 1221) for that and other parts, respectively mention, among miscellaneous commodities, "Carrega de Brasill," "faix de bresil" and "cargua de brazil." The usual impost seems to have been two solidos. One of these lists mentions "grana" unqualified. There seems nothing to indicate what material was or was not meant, except the slight negative value of that reference.

It is interesting to see the variations of orthography in these lists, duplicating those of the Brazil west of southern Ireland on the fourteenth and fifteenth century maps, though Fra Mauro adds berzil and the more southern apparently imitative Brazils (Terciera and others) exhibit further vagaries of spelling. The first appearance of Brazil in geography seems to be, so far as reported, south of west of Limerick on the 1325 map of Dalorto.

Was it thence that the "grain" of 1193 and 1198 was supposed to have come? It can hardly be an error for dyes or dye woods, though both grain and dye wood may have been associated with the idea and name of Brazil, as we still write both India-ink and India-rubber.

W. H. Babcock

CONCERNING GOVERNMENT APPLICATION BLANKS

To the Editor of Science: In former times when one wished to institute a comparison between the various classes of liars, he was accustomed to say "he lies like a horse-thief," or "he lies like a tombstone." Now, however, those of us who are connected with the teaching profession are given to saying "he lies like a testimonial."

It seems a little too bad that one's natural tendency towards mendacity should be accelerated by no less a person than Uncle Sam. Some time ago I was asked to fill out a blank for an applicant for a teaching position in the Philippine Islands, and among other questions asked me were the following:

8. Is the applicant now, or has he ever been, addicted to the use of intoxicating beverages, morphine or opium?

14. Can you state positively that the applicant's character is unimpeachable, and his reputation for sobriety and morality unquestionably good?

The printed directions state that all questions must be answered and that to say "I don't know" is unsatisfactory. Now I feel confident that the young lady who did me the honor to ask me for a testimonial has not been addicted to the use of intoxicating beverages, morphine, or opium; but I could not make this statement as a positive fact about her or any other acquaintance of mine. Again, I believe the applicant's character to be unimpeachable, but I can not state positively that such is the case. This is a world of surprises and disappointments. I am most optimistic, but not sufficiently so to answer these questions in the affirmative. May we not hope that our new president-elect will take measures to relieve the tender consciences of college professors from the great strain that these government blanks put upon them?

James S. Stevens
University of Maine

SCIENTIFIC BOOKS

Richtlinien des Entwicklungs- und Vererbungsproblems. By Alfred Greil, Professor of Anatomy, Innsbruck. Jena, Gustav Fischer. 1912. 2 parts.

The crude evolutionism of Bonnet gave place to the epigenesis of C. F. Woeff, and this, too indefinite to give sufficient explanation of the phenomena of cell differentiation, adaptation and inheritance, in turn was supplanted by a newer preformationism, at first

also rather crude, but later becoming more and more refined, until finally it has become almost if not quite metaphysical. To Professor Greil, however, preformationism in any of its forms is a stone of stumbling and a rock of offense, and in the two volumes now before us he attempts to recall the feet of the faithful to the paths of epigenesis, by what he terms, with insistence, a formal or descriptive analysis of the phenomena of development.

He starts, however, with a basic proposition, "the true and fundamental principle of rational comparative embryology," which he expresses in the words of Haeckel, "Aus Gleichartigem Ungleichartiges." He is thus an epigenesist of the epigenesists and his method of analysis is to proceed from this assumed truth to reconstruction of the embryological history. The first part of the treatise is practically a reprint of a paper recently published in the *Zoologische Jahrbücher*[1] and is a description of the phenomena of development as seen by a thorough-going epigenesist, who is also a firm believer in the biogenetic law. In the second part special problems, such as adaptation and variability, inheritance and sex-determination, are similarly surveyed and in a somewhat extended appendix the various theories of Roux, R. Hertwig, Rabl, Mehnert, Kassawitz, Fick and Godlewski are reviewed and criticized, with the same richness of dialectic that pervades the entire work.

For the author wields the pen of a ready writer, which unfortunately frequently leads him into unnecessary repetitions and verbosities, which extend over seven hundred pages what might have been clearly and forcibly presented in perhaps half the space, to the greater comfort and satisfaction of the reader. But even with due allowance for redundancies, the ground covered is so extensive as to preclude the possibility of a review or even a bare enumeration of the various questions discussed, and it must suffice to repeat that the main thesis of the work is the all-sufficiency of epigenesis. That is the one and only power, and formal analysis is its prophet. Professor Greil presents a strong case, but it must be confessed that he does not and, indeed, in the present state of our knowledge, he can not yet remove the difficulty that has forced so many thinking zoologists into preformationism, namely, an explanation of how differentiation is possible by epigenesis. One may glibly talk of cellular interaction, of effects produced by quantity and quality of the food and by the outside environment, and of the determination resulting for the chemical constitution of the ovum, but until we have concrete evidence of how these or other factors act in the production of differentiation epigenesis will continue to be no explanation. And, after all, if the last named of the above factors be admitted, is it not merely carrying preformationism back to its ultimate limits and making it identical with epigenesis?

J. P. McM.

[1] A. Greil, "Ueber allgemeine Richtlinien des Entwicklungs- und Vererbungsprobleme," *Zool. Jahrb.*, Bd. XXXI., Abt. für allgem. Zool. und Physiol. der Tiere, 1912.

Origin and Antiquity of Man. By G. FREDERICK WRIGHT, D.D., LL.D., F.G.S.A. Oberlin, Ohio, Bibliotheca Sacra Company. 1912. Pp. xx + 547. Illustrated.

As an introduction Professor Wright discusses the origin and antiquity of the earth. He inclines toward a very moderate estimate of the length of geologic time and hence of the human period, which began when man became a tool-user. To him the ancient civilizations of Babylonia, Egypt, Crete and Central Asia were of a high order. These rare blossoms in the springtime of history were each nurtured by exceptional geniuses instead of being the product of a gradual unfolding.

The diversity of languages is invoked as an aid in the measurement of man's antiquity. In view of the rapidity with which children when isolated invent a language of their own, the author believes the evidence of an extremely great antiquity of the human race drawn from the diversity of language at the dawn of history to be far from conclusive.

In the chapter on the "Origin of the Races of Europe" (p. 105), the author states that

the stone implements of the Scandinavian shell heaps "have usually been polished and sharpened by rubbing; this justifying their assignment to the 'smooth stone age.'" The fact is, artifacts of polished stone characterize a later stage and not the early shell-heap phase of the neolithic. Neither do the "chipped flint daggers of exquisite form" and the perforated diorite axes (pp. 125–126) come from the "kitchen middens," but from the stone cist burials of a later epoch. The statements that the Cro-Magnon race is of neolithic age (p. 115) and that it did not appear until after the mammoth had become extinct (p. 116) would not be admitted by the best authorities. Cro-Magnon is paleolithic and the mammoth lived on until the close of the Magdalenian, as attested by the mural art of the caverns, especially at Font-de-Gaume; and hence was a contemporary of the Cro-Magnon race. In the same paragraph by inference one is led to suppose that the engraved figure of a reindeer from Thayngen is the work of a neolithic craftsman; when on the contrary it is paleolithic.

As might be expected of Professor Wright, much space is devoted to man and the Glacial period, not only in the old world, but also in the new. His estimates of the length of time that has elapsed since the beginning of the Glacial period are moderate. He believes that the Glacial period was practically a unit, there being four phases instead of four distinct epochs, thus differing from some of the most noted living glacialists. The cause of the Glacial period is assigned to land elevation and its disappearance to a subsidence, factors which probably played a rôle in the great climatic drama, but which might have been correlated with other factors such as the changing condition of the sun itself and in the atmosphere.

But little space is given to cultural and somatic evolution, in which field many important results have recently been achieved. The Magdalenian polychrome frescoes on the cavern ceiling at Altamira are referred to as of Aurignacian age, an error into which Sollas ("Ancient Hunters") also fell.

The author's point of view might possibly be best reflected in a few quotations: "Our earliest knowledge of man is of a being fully formed and in possession of all the faculties of his kind" (p. 389). "On the important question of man's first arrival on this planet we may for the present possess our minds in peace, not a trace of unquestionable evidence of his existence having been found in strata admittedly older than the Pleistocene" (pp. 341–2). "The simple arithmetical calculations made above show that when once started, the dispersion over the world, the diversification of the races, the differentiation of languages, and the development of ancient civilization may easily have come about in the course of four or five thousand years, if not in half that time, and that the extension of prehistoric time for eight thousand years affords superabundant opportunity for the growth and development of all the peculiarities and institutions of man as first made known to us at the dawn of history" (p. 493). "The antiquity of man therefore so far as the question depends upon his connection with the Glacial epoch, is not proved to be, even when we allow a generous margin, greater than twelve or fifteen thousand years" (p. 494).

The chapter preceding the "Summary and Conclusion" treats of "The Biblical Scheme." The work has the welcome merit of an engaging style, possessing to a degree the charm of the author's personality. Another attractive feature is the "Appendix" of copious notes and references.

George Grant MacCurdy
Yale University

SPECIAL ARTICLES

NEW AND EXTINCT BIRDS AND OTHER SPECIES FROM THE PLEISTOCENE OF OREGON

Many years ago I published in the *Journal* of the Academy of Sciences of Philadelphia an account of the fauna of the Oregon desert region during Pleistocene time. This account was based upon a large collection of fossils sent me for the purpose by the late Professor E. D. Cope, who, with his assistants and a

few other naturalists, had brought this valuable material together. By far the greater part of this consisted of the fossil bones of birds, the mammals and fish having been described by Professor Cope in *The American Naturalist* and elsewhere.

The results of my share of the work have long since passed into the literature of the subject; and, as these are fully set forth in my academy memoir, they need not be especially reviewed in this place. It may only be noted that I announced, for the first time, the discovery of a long list of birds, based on the fossils referred to, the majority of which coincided with species and genera of existing forms, while a somewhat formidable array were extinct and new to science.

At the time my examination was made, the skeletons of existing birds at my command were entirely inadequate for the purposes of making reliable diagnoses and references. During the past twenty years, however, such material has been vastly increased in our museums, especially in the U. S. National Museum, and for the use of this in the present connection I am much indebted.

Several years ago, what may be collectively designated as the Cope collection from the aforesaid region was purchased by the American Museum of Natural History in New York City for its paleontological department; and only a few months ago Dr. W. D. Matthew, the curator of that department, shipped me to Washington the entire collection for the purpose of a complete revision. This task is now practically completed, and the object of the present article is simply to publish an advance abstract as an announcement of the additional birds of the region in question, the fossil remains of which I have found to exist in the aforesaid collection, and a small collection from the same localities (Silver and Fossil lakes), which belongs to the U. S. National Museum. The new species will be fully described in the forthcoming contribution on the subject, accompanying which will be found upwards of 600 figures illustrating the entire avifauna of the Pleistocene of Oregon, in so far as their fossil remains are concerned.

The list is as follows, each species in it, with one exception, being announced for the first time:

1. *Colymbus parvus* (extinct).
2. *Podilymbus magnus* (extinct).
3. *Centrocercus urophasianus.*
4. *Mergus americanus?*
5. *Mergus serrator.*
6. *Mergus* sp.?
7. *Marila americana?*
8. *Marila valisineria.*
9. *Marila marila.*
10. *Marila affinis?*
11. *Marila collaris?*
12. *Charitonetta albeola.*
13. *Histrionicus histrionicus.*
14. *Polysticta stelleri.*
15. *Erismatura jamaicensis.*
16. *Branta c. hutchinsi?*
17. *Branta c. minima?*
18 *Branta bernicla.*
19. *Olor columbianus.*
20. *Olor buccinator.*
21. *Olor matthewi* (extinct).
22. *Ardea herodias.*
23. *Botaurus lentiginosus.*
24. *Aquila chrysaëtos.*
25. *Haliæetus leucocephalus.*

Erismatura jamaicensis has been previously announced by Mr. L. H. Miller in the *Bulletin* of the Academy of Natural Sciences of California. The three new extinct birds found, and the descriptions of them, will appear when the memoir is published.

R. W. SHUFELDT

November 18, 1912

PROCEEDINGS OF THE ENTOMOLOGICAL SOCIETY OF AMERICA

THE seventh annual meeting of the Entomological Society of America was held at Cleveland, Ohio, December 31 and January 1, in the auditorium of the Normal School. The meetings were all well attended and enthusiastic. The following papers were presented:

C. BETTEN, Lake Forest University: *An Interesting Feature in the Venation of Helicopsyche, the Molannidæ and the Leptoceridæ.*

In the trichopterous genus *Helicopsyche* radius of the fore wing is found in primitive condition, *i. e.*, R_1 is simple and the sector is dichotomously branched. The homology is but slightly obscured

by the fact that the cross vein *r–m* is in direct line with the distal part of R_5, making the latter appear to arise from *M*. It is suggested that the same interpretation should be made in the case of the Molannidæ and the Leptoceridæ. In these families R_5 has more definitely assumed relations with *M*, with which vein its distal part may be wholly fused. This interpretation is based not only on comparison with *Helicopsyche*, but also upon the fact that it leaves the "corneous point" within cell R_4, where it occurs in all other families if it occurs at all. The venation of the hind wings of these forms is similarly interpreted.

Lucy W. Smith, Mt. Holyoke College: *Mating and Egg-laying Habits of Perla immarginata.*

In introduction the paper gives a general description of the method of keeping adult stoneflies under observation in captivity, and of handling their eggs. This is followed by a detailed account of the genital armature, copulation and egg-laying habits of a single species, *Perla immarginata.*

Alvah Peterson, University of Illinois: *Head and Mouth Parts of Cephalothrips yuccæ.*

A preliminary report on the asymmetry of the mouth-parts of Thysanoptera. A detailed description of the anatomy of the mouth-parts and head capsule of *Cephalothrips yuccæ*, a species belonging to the suborder *Tubulifera*, was given. Numerous details and parts heretofore undescribed as to mandibles, hypopharynx, epipharynx, arms of tentorium, etc., were shown. Similar observations were made on *Anthothrips verbasci* in order to verify results found in *Cephalothrips yuccæ.*

Comparing the work done by H. Garman on *Limothrips cerealium*, a species of Terebrantia, with the work done by Muir and Kershaw on a species of Tubulifera, a difference in interpretation exists as to whether the asymmetrical parts are mandibles or maxillæ. Muir and Kershaw interpret the asymmetrical parts as maxillæ. Observations made by the writer on two species of Tubulifera verifies their position in general. The writer expects to continue his observations on species of the suborder of Terebrantia to determine if possible whether the interpretation of H. Garman is correct or not.

J. E. Wodsedalek, University of Wisconsin: *Life History and Habits of Trogoderma tarsale, a Museum Pest.* Read by title.

Leonard Haseman, University of Missouri: *Life Cycle and Development of the Tarnished Plant Bug, Lygus pratensis Linn.* Presented by the secretary.

Owing to the very serious injury to peach and pear in the early spring which seemed to be due to the work of the tarnished plant-bug, the writer has undertaken a careful study of the life cycle, habits and development of this insect. The work has been carried through the late summer and fall months and will be continued throughout the following spring and summer.

In this work it has been found that the tarnished plant-bug breeds largely upon various flowering weeds, such as wild asters, daisies and mare's tail (*Erigeron canadensis*). The tarnished plant-bug deposits its eggs in the blossoms of the host plant and not in the tissue of the leaves or stems. These eggs hatch in from five to seven days and the insect passes through five distinct nymphal stages in its development in the place of four, as other writers have maintained. The insect remains in each nymphal stage for about the same length of time and completes its growth in from thirty to thirty-five days.

Victor E. Shelford, University of Chicago: *The Ontogomy of Elytral Pigmentation in Cicindela.*

The pigment develops in the form of a faint pattern, somewhat variable, but with certain lighter areas occurring in the same general position in several species. These lighter areas lie between the tracheæ and in certain transverse bands; their position corresponds to those of certain white markings of Ethiopian and Oriental species.

N. L. Partridge, University of Illinois: *The Tracheation of the Pupal Wings of some Saturnians.*

A method of preparing permanent mounts of lepidopterous pupal wings was described. The pupal wings were removed in the customary manner and the specimens secured, floated upon clean water to straighten the wings and remove any dirt which might adhere to them. Then they were placed on a clean, untreated glass slide, smoothed and allowed to dry, without further treatment. The result was a transparent mount showing all the tracheoles as well as the tracheæ. Some of these mounts were used as lantern slides, giving clear images on the screen.

It was shown that a greater amount of variation was found in the pupal wings than in the adult wings. The homologies between the tracheæ and veins, of the specimens shown, was indicated.

L. B. Walton, Kenyon College: *Studies on the Mouth-parts of Rhyparobia maderiæ (Blattidæ)*

with a consideration of the Homologies existing between the Appendages of the Hexapoda.

The question as to the homologies existing among the paired appendages of the Hexapoda has received attention from various investigators, and in particular from Hansen, Heymons, Borner, Verhoeff and Escherig, none of whom, however, have progressed far toward a satisfactory solution of the problem. In general it has been accepted that the stipes and mentum corresponded to the thoracic and abdominal coxæ while the maxillary and labial palpi were equivalent to the trochanter, femur, etc., of the functional leg.

Studies on *Rhyparobia maderæ*, the "giant cockroach" from Panama, particularly of 10 mm. and 12 mm. embryos, as well as other investigations in connection with the appendages of the Thysanura, make it evident that the typical appendage (mouth parts, thoracic, abdominal, caudal) of the Hexapoda consists of seven definite areas best represented by the maxillæ with the galea, lacina, ectostipe,[1] endostipe, ectocardo, endocardo and palpus. Furthermore, the palpus should be homologized with the stylus of the thoracic and abdominal coxæ and not with the functional leg, inasmuch as both palpus and stylus are appendages of homodynamous areas (ectostipe, ectomentum, meron) while the leg is an appendage of the area (endocoxa) corresponding to the endostipes.

The facts noted suggest the origin of the biramose appendage of the Hexapoda directly from the parapodium of the Polychæta, the notopodium and neuropodium arising in connection with the dorsal and ventral bundles of setæ and corresponding to the outer (ectal) and inner (endal) groups of sclerites as outlined above. It would thus appear that the Arthropoda are a polyphyletic group, and that the relationship between the appendages of the Hexapoda and Crustacea is a more remote one than generally accepted in connection with the studies of Hansen and Borner.

The historical development of the problem as well as the presentation of the facts which would seem to establish the views here advanced, will appear in the completed paper, of which this is a partial summary.

JAMES ZETEK, Sanitary Commission Canal Zone: *Determining the Flight of Mosquitoes.* Read by title.

[1] The prefixes "ecto" and "endo" have been utilized in an attempt to establish a better nomenclature, while minor changes have been made in the terminology of older parts, *e. g.*, "ectostipes" is a more cumbersome term than "ectostipe."

WILLIAM A. RILEY, Cornell University: *Some Sources of Laboratory Material for Work on the Relation of Insects to Disease.*

The demand for at least elementary courses on the relation of insects to disease brings up the question as to available laboratory material. There is comparatively little difficulty in obtaining the parasitic mites, ticks, lice, house-flies, mosquitoes and fleas in their various stages, but it is usually assumed that most of the pathogenic Protozoa are tropical species and that nothing can be substituted for them in laboratory work. As a matter of fact, a number of insect-borne Protozoa and worms occur in this country and, together with other blood parasites whose life-history is less better known, are available for laboratory work. The species discussed were *Trypanosoma lewisi*, a widely distributed parasite of brown rats; *Trypanosoma rotatorium* from the frog; the related *Crithidia* from the "sheep tick"; *Herpetomonas* from the house-fly; *Monocystis* from the seminal vesicles of the earthworm as introductory to the study of the Hæmosporidia; *Lankesterella ranarum*, *Hæmogregarina* sp.; *Proteosoma*, *Halteridium*, *Babesia hilaria* in the blood of the crow and English sparrow, and *Dipylidium caninum*, the double-spored tapeworm of dogs, cats and man.

Y. H. TSOU and S. B. TRACKER, University of Illinois: *The Homology of the Body Setæ of Lepidopterous Larvæ.*

This paper consisted (1) of a statement of the difficulties involved in homologizing the body setæ of these larvæ, (2) of a consideration of the serial homology of the setæ of the different segments and (3) of the specific homology in the larger groups. Greek letters were employed to designate the setæ in order to obviate the confusion which has arisen from the use of numbers in different ways by different authors. The prothorax of *Hepialus* was shown to represent the primitive arrangement of setæ and was used as a type for determining the homology of the setæ on the different segments. The authors had studied many species and gave figures of four: *Hepialus lectus* and *H. humuli* of the Jugatæ, *Pseudanophora arcanella* of the Tineidæ and *Mamestra picta* of the Noctuidæ. Each of these was compared with the type, segment for segment. This is the first time the setæ of the prothorax have been homologized with those of the other segments.

ANNA H. MORGAN, Mt. Holyoke College: *Eggs and Egg-laying of May-flies.*

This study of May-fly eggs was made to determine the relative fecundity of different species. This led to the study of a series of elaborate sculpturings found upon the chorion. In several species the chorion bears long thread-like extensions which terminate in viscid spheres or disks. These seem to help buoy up the eggs. Threads two and three inches long were found. In nature these threads are probably entangled in sticks and vegetation and this prevents the eggs from being covered by silt. In the ovaries of half-grown nymphs these structures are well defined and are of aid in connecting up the life histories where rearing is impossible.

HERBERT OSBORN, Ohio State University: *Notes on Cicadidæ with Especial Reference to the Ohio Species.*

Cicadas constitute a conspicuous element in insect fauna and their relation to varied forest conditions is discussed especially for the species occurring in Ohio. The origin and function of the tympanal organs present problems for study and the suggestion is made that this structure is primarily a secondary sexual character functioning in sexual excitation and only incidentally a sound-producing organ.

FRANK E. LUTZ, American Museum of Natural History: *On the Biology of Drosophila ampelophila.*

This insect is remarkably useful in laboratory work, since it can be kept going throughout the year on bananas as food and its short life-cycle (about ten days to two weeks) enables one to get a large number of generations. Sexual difference characterizes the insect. Not only do the sexes differ in adult color and structure, but they differ in the duration of the immature stages, in their reactions to light and the age at death.

E. P. FELT, State Entomologist, New York: *Observations on the Biology of a Blow-fly and a Flesh-fly.*

A study of *Phormia regina* Meign. and *Sarcophaga georgina* Wied. was undertaken primarily for the purpose of obtaining data which could be used as a basis for estimating the period a human body had laid exposed to the elements in midsummer. Our knowledge of these two species is summarized and original data are given on the habits and duration of the various stages under known climatic conditions. The egg of *Phormia* and the three larval stages and puparium of both species are described and a bibliography of each appended.

EDITH M. PATCH and WILLIAM C. WOODS, Maine Agricultural Experiment Station: *A Study in Antennal Variation.* Read by title.

ALEX. D. MACGILLIVRAY, University of Illinois: *Propharynx and Hypopharynx.*

The pharynx after entering the occipital foramen makes a distinct bend toward the mouth. In the region of the clypeus it divides transversely, one half passes to the clypeo-labral side, the other half to the labial side of the mouth, while folds extend along each lateral margin and unite with the mandibles and maxillæ. The name of propharynx is proposed for the portion lying adjacent to the clypeo-labral part of the mouth and hypopharynx is used for the portion lining the labial portion. The propharynx consists of three parts: frontal lobe, epipharynx and fulcrum. The frontal lobe is usually wanting in sucking insects, the epipharynx is modified into a tongue or piercing organ and the fulcrum into a cuticular supporting plate. In the muscids the epipharynx and fulcrum are located outside of the mouth, the proximal end of the fulcrum is attached to the distal margin of the labrum. The hypopharynx also consists of three parts: lingua, superlingua and pharangial sclerites.

T. L. WASHBURN, State Entomologist, Minnesota: *A Few Experiments in Photographing Living Insects.*

THOMAS J. HEADLEE, New Jersey Agricultural Experiment Station: *Some Facts Regarding the Influence of Temperature and Moisture Changes on the Rate of Insect Metabolism.*

While connected with the Kansas State Experiment Station at Manhattan, the writer found by subjection of different groups of the southern grain louse (*Toxoptera graminum* Rodani) to various constant temperatures under constant atmospheric moisture conditions and other groups to various constant percentages of relative humidity under constant temperature conditions: (1) that the rate of increase in metabolism for each 10° F. increase in temperature, starting at 50° F., decreases as the optimum temperature is approached, and that while the metabolism of degeneration becomes more rapid after the optimum is passed the rate of growth is retarded; (2) that a variation of from 60 to 62 per cent. in atmospheric moisture does not affect the rate of metabolism when the creatures have an abundant supply of succulent food.

Similar tests of the effect of temperature on the rate of metabolism in *Lysiphlebus tritici* Ashm. and of the effect of temperature and moisture on the rate of metabolism of the chinch bug (*Blissus leucopterus* Say) infected and uninfected by the chinch-bug fungus (*Sporotrichum globuliferum* Speg.) gave similar results.

J. T. Abbott, Washington University: *The Strigil in Corixidæ and its Probable Function.* Read by title.

Edna Mosher, University of Illinois: *The Anatomy of some Lepidopterous Pupæ.* (Presented by Mr. Alvah Peterson.)

Figures of pupæ of three species were shown; also figures of the pupæ with the cases dissected away so as to show the parts underneath. Considerable difficulty has been encountered in homologizing the pupal structures from the external appearance, particularly in the case of the fixed parts of the head and the appendages of the head and thorax. The leg cases were shown to be a frequent source of error. Instead of showing externally only the cases for the tibiæ and tarsi, as Scudder claims is the case in the butterflies, certain forms show the femur cases and either the whole or part of the coxal cases in certain pairs of legs. What Packard calls the paraclypeal pieces, were shown in these forms to contain functionless mandibles which had their distal margins toothed in the case of *Lymantria*.

This detailed anatomical study is to be made the basis for a phylogenetic and taxonomic arrangement of the Lepidoptera based on an examination of the characters of the pupæ.

Charles K. Brain, Ohio State University: *Some Anatomical Studies of Stomoxys calcitrans Lin.* (Introduced by Professor Herbert Osborn.)

The external mouth-parts and digestive system of both sexes of this species are identical in structure, and both sexes suck blood. The external mouth-parts consist of maxillary palpi and proboscis; the latter consisting of labrum, hypopharynx and the labium.

The digestive system consists of proboscis, pharynx, œsophagus, proventriculus, intestine, rectum and the appendages, viz., salivary glands, sucking stomach and Malpighian tubes. The two Malpighian tubules of the left Malpighian tube have much thickened ends, which lie dorsally. Those of the right side have no such thickened ends. The male reproductive organs consist of a pair of spherical testes which appear orange-colored in dissections, owing to their pigmented sacs, their ducts leading into the common vesicula seminalis, the ejaculatory duct and the penis.

The female reproductive organs consist of the ovaries, oviducts, uterus and ovipositor, with the appendages, the uterine glands and the receptacula seminis.

S. W. Bilsing, Ohio State University: *Observations on the Food of Spiders.* (Introduced by Professor Herbert Osborn).

Spiders are known to feed upon insects, but exact records of kind and quantity of food for particular species are very meager. Extended observations and records were made during the summer and fall of 1912 and data from some of these are presented. As an example of the records given, grasshoppers constituted 39 per cent. of the food of *Miranda aurantia*, 59 per cent. of the food of *Agalena nævia* and 22 per cent. of the food of *Aranea trifolium* during the period under observation.

Herbert Osborn, Ohio State University: *Observations on Insects of a Lake Beach.*

The insect fauna of the Cedar Point Beach of Lake Erie is discussed with reference to its derivation and adaptation for the conditions presented. The insect drift, the migrant and the resident members of the association are separated and records of species in each group given.

C. H. Tyler-Townsend, Government Entomologist of Peru: *The Species-Status and the Species-Concept.* Read by title.

C. H. Tyler-Townsend, Government Entomologist, Peru: *A New Application of Taxonomic Principles.* Read by title.

The annual public address of the society was given on Wednesday evening, January 1 in the auditorium of the Normal School by:

Dr. Philip P. Calvert, University of Pennsylvania: *An Entomologist in Costa Rica.*

There was briefly recounted certain physical and meteorological features of that country which render it very favorable for the study of the influence of these factors on the distribution and habits of plants and animals. A few localities, selected from those in which the speaker had worked during the year from May, 1909, to May, 1910, were described and their fruitfulness illustrated by some of the discoveries made of the habits and life histories of the Odonata (dragonflies) obtained therein.

The following officers were elected for the ensuing year:

President—C. J. S. Bethune.
First Vice-president—Philip P. Calvert.
Second Vice-president—W. M. Marshall.
Secretary-Treasurer—Alex. D. MacGillivray.
Additional Members of the Executive Committee—Herbert Osborn, C. P. Gillette, V. L. Kellogg, J. G. Needham, C. T. Brues and Nathan Banks.
Member of Committee on Nomenclature for three years—E. P. Felt.

ALEX. D. MACGILLIVRAY,
Secretary

SOCIETIES AND ACADEMIES

THE BOTANICAL SOCIETY OF WASHINGTON

THE eighty-fifth regular meeting of the Botanical Society of Washington was held at the Cosmos Club, Tuesday evening, January 7, 1913.

The following scientific program was presented:

DR. DAVID GRIFFITHS: *Performances in Species of Opuntia.* (Illustrated with lantern slides.)

This paper will be published in the near future as a bulletin of the Bureau of Plant Industry.

MR. J. B. NORTON: *Some Interesting Facts Concerning the Genus Asparagus.* (Illustrated with lantern slides.)

This paper gave a review of the interesting features connected with the work of breeding a rust-resistant variety of asparagus. *Asparagus officinalis* has never been found to be completely immune to the attacks of its rust, *Puccinia asparagi*. Plants nearly immune to the destructive summer stages show no resistance to the æcidial stage of the fungus. Resistance seems to be due to morphological causes. Related species are attacked by the rust, but the members of other sections of the genus seem immune. The genus *Asparagus* and its relatives are entirely limited to the old world, the majority being African. A study is being made of the relationships of this group and many new characters based on the manner of growth, roots, stems, leaf scales, cladodes, etc., have been found. The arrangement of the stomata on the cladodes is very characteristic in the various groups. The old genus *Asparagus* contains several very distinct groups of species entitled to generic rank.

Only one hybrid form of known parentage has been secured, a cross between *A. officinalis* and *A. davuricus*. Many other combinations have failed to produce seed. Asparagus grows rapidly—some species average nine inches per day. The seed germination takes from 12 days with *officinalis* to 60 or more days with some African species. Several new ornamental forms were described.

C. L. SHEAR,
Corresponding Secretary

THE TORREY BOTANICAL CLUB

THE meeting of November 12, 1912, was held at the American Museum of Natural History. President Burgess presided.

The announced scientific program consisted of an illustrated lecture by Dr. J. J. Levison on "Tree Problems of our City."

THE meeting of November 27, 1912, was held in the laboratory of the New York Botanical Garden. Vice-president Barnhart presided.

The first paper was by Dr. W. A. Murrill, on "The Polypores of the Adirondacks." This paper has been published in full in the *Journal of the New York Botanical Garden*, 13: 174–178, November, 1912.

The second number was given by Dr. A. B. Stout. The subject of his discussion was "The Distribution of Tissues in the Root Tip of *Carex aquatilis*." Several photomicrographs of sections of root tips were exhibited, and drawings were made to illustrate particular features in the arrangement of the tissues.

THE meeting of December 10, 1912, was held at the American Museum of Natural History. President Burgess presided.

On the motion of Dr. Southwick the treasurer was authorized to draw an order for the sum of twenty dollars in favor of Dr. William Mansfield to cover the dues as the representative of the club to the council of the New York Academy of Sciences.

The paper of the evening was on "Diatoms," by Dr. Marshall A. Howe. It was a semi-popular account of the principal structural and morphological features of diatoms, their distribution and habitat, their geological interest and importance, the various economic uses of diatomaceous earths, etc. The talk was illustrated by about seventy-five lantern slides from the collection of the late Charles F. Cox. Many of the photographs shown were made under high powers of magnification and they brought out with much distinctness the secondary markings and other minute structural details of the walls of various types of diatoms.

B. O. DODGE,
Secretary